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SID 63-163

DATA REPORT FOR TESTS OF A 0.055-SCALE APOLLO DYNAMIC STABILITY MODEL (FD-2) TO DETERMINE FLOW SEPARATOR EFFECTS - LANGLEY 8-FOOT TRANSONIC PRESSURE TUNNEL (PROJECT 258) (U)

April 1963

CLASSIFICATION CHANGE
To UNCLASSIFIED
By authority of GDS - EO 11652 Date 12/31/72
Changed by L Shirley
Classified Document Master Control Station, NASA
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NORTH AMERICAN AVIATION, INC.
SPACE and INFORMATION SYSTEMS DIVISION

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FOREWORD

The tests to determine flow separator effects were conducted under NASA Apollo contract NAS9-150 in the Langley 8-foot Transonic Pressure Tunnel.

This report was prepared by C. E. Mitchell and C. L. Berthold of the Wind Tunnel Projects Group, Los Angeles Division of North American Aviation, Inc.

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ILLUSTRATIONS

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I. INTRODUCTION

Dynamic stability tests were conducted on the 0.055-scale Apollo FD-2 model in the Langley 8-foot Transonic Pressure Tunnel (TPT) from 23 October 1962 to 25 October 1962. This investigation was made to determine dynamic stability derivatives for the command module reentry configuration and for a later launch escape configuration (116-inch tower and 280-inch rocket) than used during previous tests.

The launch escape configurations, which were tested at Mach numbers 0.03, 0.70, 0.90, 1.00, and 1.20, included flow separator disc on and off with the oscillation center on the design center of gravity of the full-scale vehicle. Since the command module configuration had not changed, it was tested only at Mach 0.70, 1.00, and 1.20 with an oscillation center not previously used in this Mach number range. Data at this oscillation center, combined with data at three other oscillation centers from a previous 8-foot TPT test (Reference 1), will allow an investigation of a method for transferring dynamic stability derivatives to centers of gravity other than that at which the test was conducted. All of these oscillation centers were displaced from the design center of gravity because of space limitations (Figure 1).

Reynolds numbers, based on maximum model diameter, were in the order of 1.75×10^6 to 3.76×10^6. All dynamic stability derivatives were measured during forced oscillation of the model in pitch only with an amplitude of approximately ±2 degrees about the oscillation center. The launch escape configurations were run at nominal angles of attack from -12 to +6 degrees, and the command module was run from +136 to +164 degrees.

This report presents basic wind tunnel data only so that test results can be made available as early as possible. Analysis of results will be reported in a separate publication.

CO[redacted]

II. DISCUSSION

This investigation was conducted primarily to evaluate dynamic stability characteristics of the current launch escape configuration in the subsonic and transonic speed ranges. In previous tests at these Mach numbers, physical limitations imposed by the size of the model and the existing dynamic balance made it impossible to locate the oscillation center ideally on the design center of gravity of the full-scale vehicle. On the current LEV model, the command module apex was modified within the confines of the tower legs to position the balance oscillation center on the design center of gravity. Investigations were made with flow separator disc on and off (configurations $E_{52}\ T_{21}\ C_{19}$ and $E_{51}\ T_{21}\ C_{19}$).

The command module model was tested at three Mach numbers with a 0.50-inch spacer between the attach point of the model and the balance.

Several techniques are available for measuring dynamic stability derivatives of models in wind tunnels. This test was performed using the "inexorable" method in which the model is mechanically forced to oscillate in a single degree of freedom at a known angular frequency and amplitude (±2 degrees) while measurements are made of the moment required to sustain the motion. A more complete description of the apparatus and methods used can be found in References 1 and 5.

The plotted and tabular data are presented in Appendixes A and B in NASA standard coefficient form referred to the body system of axes originating at the oscillation center. Dynamic stability parameters are employed to indicate aerodynamic damping in pitch ($C_{m_q} + C_{m_{\dot{\alpha}}}$), and oscillatory longitudinal stability ($C_{m_\alpha} - k^2 C_{m_{\dot{q}}}$) for tests with oscillations in pitch for the reentry and launch escape configurations. The plotted data present these parameters as a function of angle of attack.

Because of adverse model location in the tunnel, no Schlieren photographs were taken.

[redacted]

III. MODEL DESCRIPTION

To reduce moment-of-inertia effects, the test models were constructed from lightweight materials whenever consistent with the structural integrity as established in Reference 6. The command modules were constructed of aluminum alloy (7075-T6); the escape tower was constructed of Armco steel (17-4PH SST); and the escape rocket was constructed of magnesium (QQ-M-31). All configurations were aerodynamically smooth. Photographs of the models are shown in Figures 8, 9, and 10.

The apex of the command module for the LEV configurations was modified within the confines of the tower legs to allow the oscillation center of the balance to be positioned on the design center of gravity of the full-scale vehicle (Figure 7). The command module reentry configuration had not changed from previous tests, but a 0.50-inch spacer between the model and balance attach point gave an oscillation center not tested in this Mach number range.

MODEL NOMENCLATURE

Symbol	Description	Drawing Detail No.	Sketch
E_{51}	Escape motor. Length = 279.65 in.; 36° 55' flared skirt	7121-01072-4-11	Figure 4
E_{52}	Escape motor. Length = 279.65 in.; 36° 55' flared skirt with 65 in. dia. flow separator disc and fairing from disc to skirt	7121-01072-4-6-11	Figure 4
T_{21}	Tower structure. Length = 116.1 in.	7121-01072-9	Figure 5
C	Command module. Max. dia. = 154.0 in.	7121-01059	Figure 6
C_{19}	Command Module. Max. dia. = 154.0 in.; apex altered to correctly position balance.	7121-01072-3-5-7	Figure 7

FULL-SCALE DIMENSIONS

Escape Rocket, E_{51}

Total length	279.65 in.
Diameter	26.00 in.
Nose radius	2.00 in.
Nose included angle	30.00 deg
Skirt base diameter	54.60 in.
Skirt flare angle	36.92 deg
Diameter of ring forward of skirt	28.87 in.

Escape Rocket, E_{52}

Same as E_{51} with flow separator disc located 19.16 in. from base of rocket motor and a fairing extending from aft end of disc to flared skirt.

Flow separator disc diameter	65.00 in.
Flow separator disc thickness	2.00 in.
Fairing diameter	51.08 in.

Tower, T_{21}

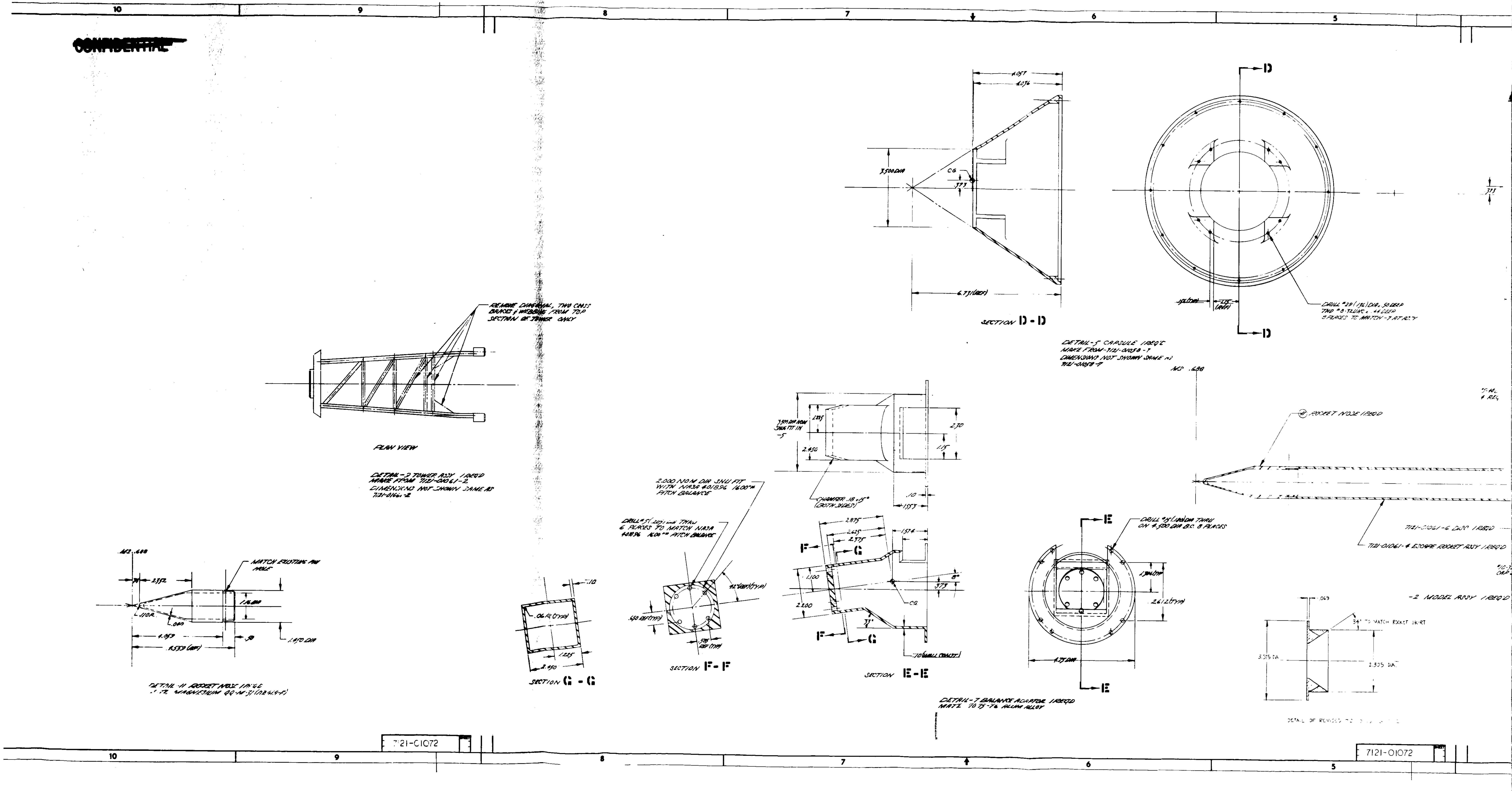
Total length	116.10 in.
Diameter of longitudinal members (4 members)	3.40 in.
Diameter of cross braces	2.49 in.
Diameter of diagonal braces	2.49 in.
Distance between attach points	50.18 in.

Command Module, C

Maximum diameter	154.00 in.
Radius of spherical blunt end	184.80 in.
Corner radius	7.58 in.
Nose cone semiangle	33.00 deg
Nose cone vertex radius	15.40 in.
Frontal area	129.35 ft^2

Command Module, C_{19}

Same as C except apex was modified within the confines of the tower legs to allow the oscillation center of the balance to be positioned on the design center of gravity of the full-scale vehicle.



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REMOVE DIAGONAL, TWO CROSS BRACES & WEBBING FROM TOP SECTION OF TOWER ONLY
PLAN VIEW
DETAIL-2 TOWER ASSY 1 REQ'D MAKE FROM 7121-01061-2. DIMENSIONS NOT SHOWN SAME AS 7121-01061-2
SECTION D - D
DETAIL-5 CAPSULE 1 REQ'D MAKE FROM 7121-01058-7 DIMENSIONS NOT SHOWN SAME AS 7121-01058-7
ROCKET NOSE 1 REQ'D
7121-01061-4 ESCAPE ROCKET ASSY 1 REQ'D
-2 MODEL ASSY 1 REQ'D
MATCH EXISTING PIN HOLE
DETAIL-11 ROCKET NOSE 1 REQ'D
SECTION G - G
SECTION F - F
SECTION E - E
DETAIL-7 BALANCE ADAPTOR 1 REQ'D MAT'L 7075-T6 ALUM ALLOY
34° TO MATCH ROCKET SKIRT
7121-01072
7121-01072

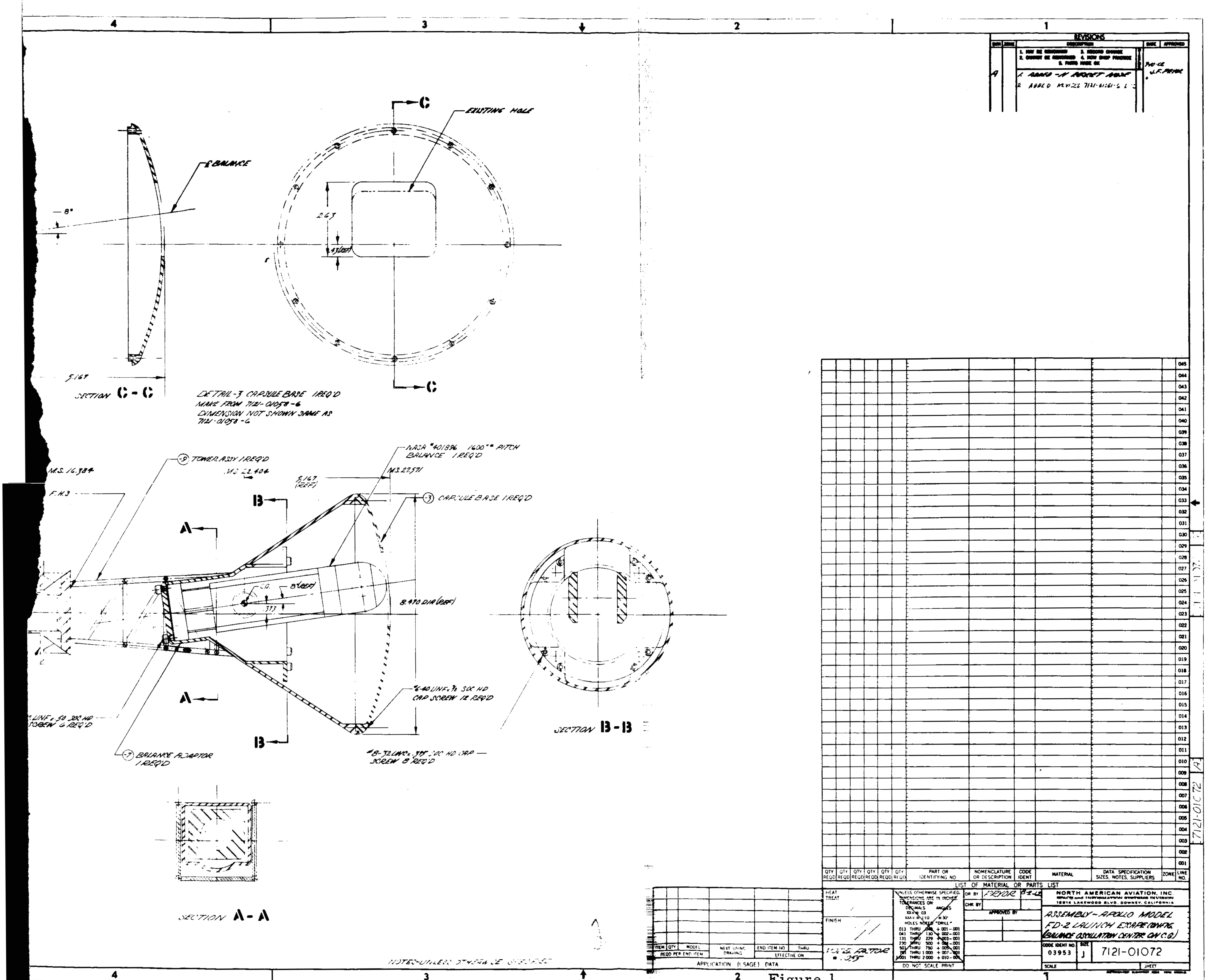
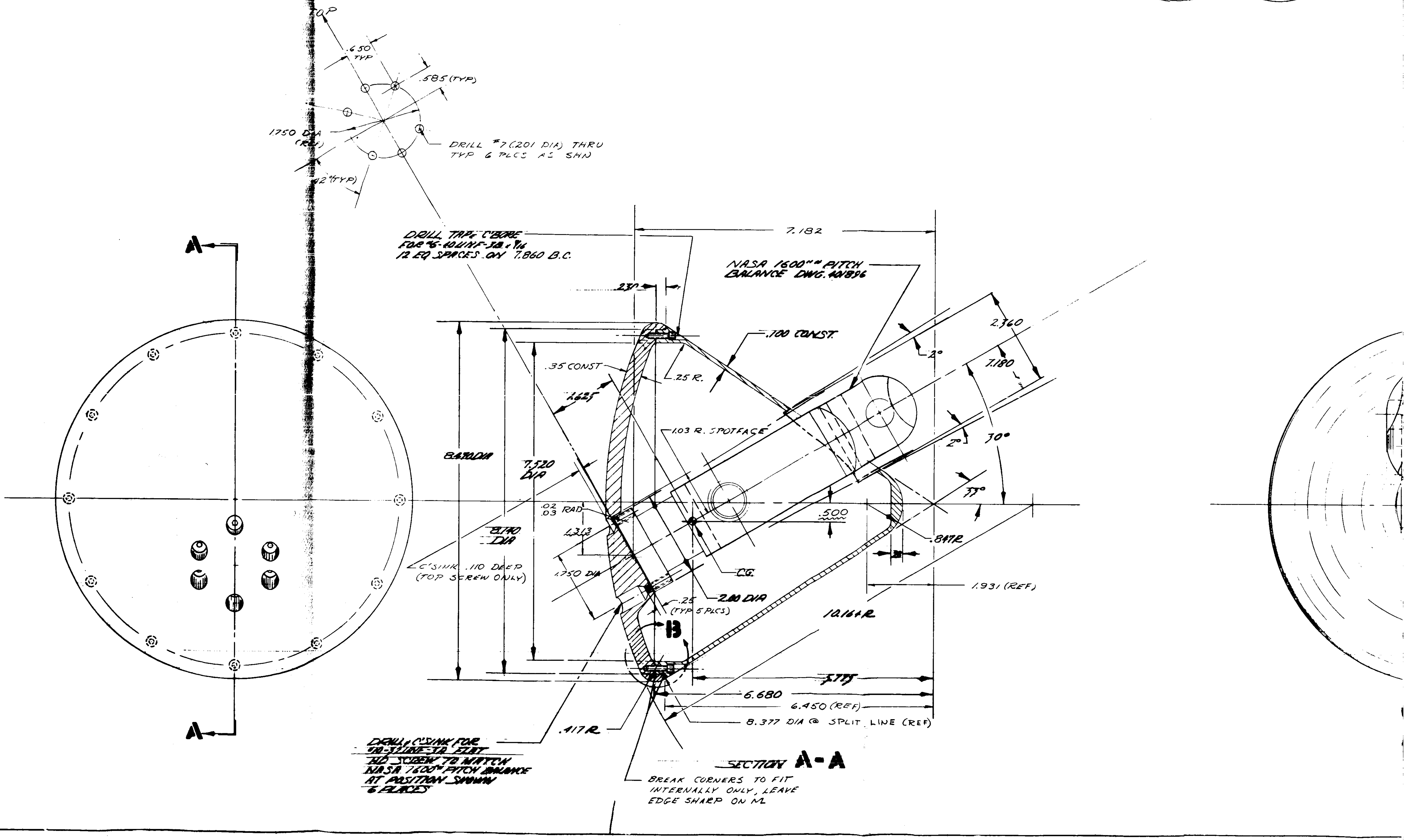
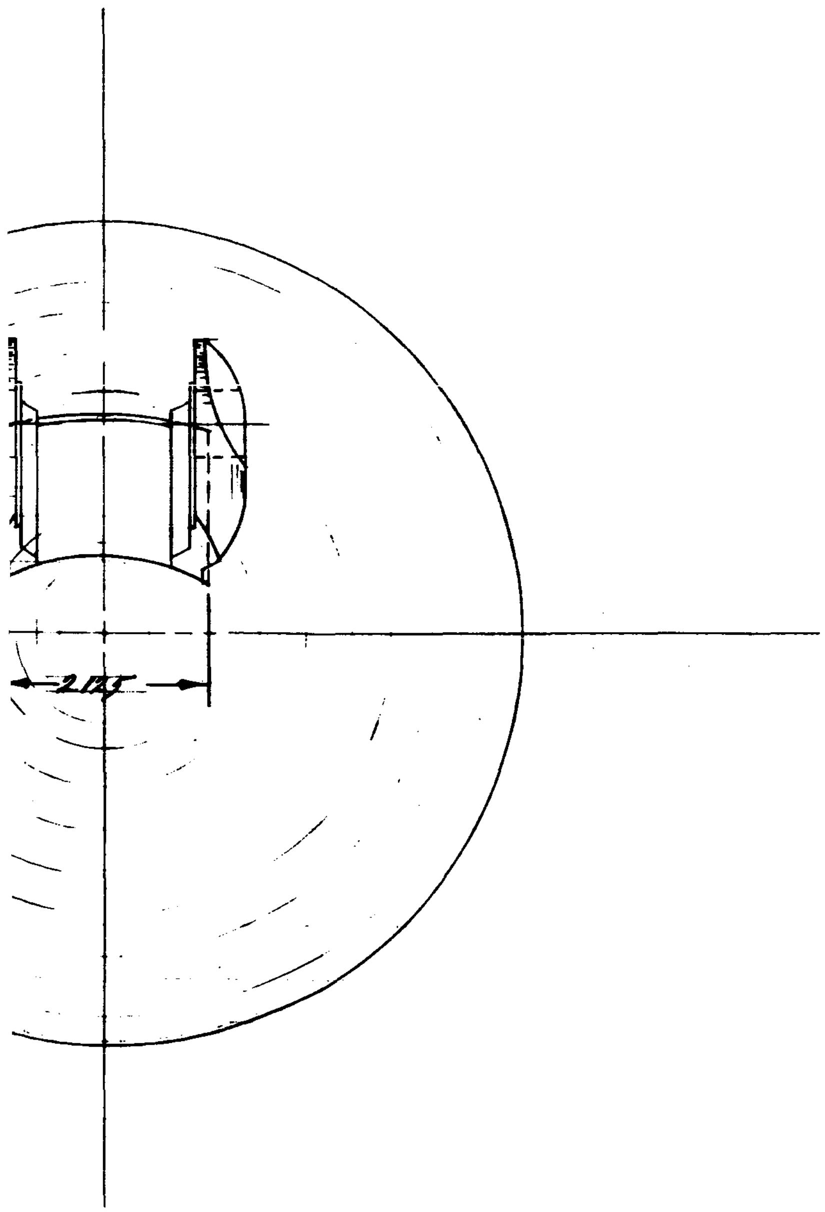

EXISTING HOLE
SECTION C - C
DETAIL-3 CAPSULE BASE 1 REQ'D
MAKE FROM 7121-01058-6
DIMENSION NOT SHOWN SAME AS
7121-01058-6
TOWER ASSY 1 REQ'D
CAPSULE BASE 1 REQ'D
BALANCE ADAPTOR
1 REQ'D
8.470 DIA (REF)
SECTION B - B
SECTION A - A
QTY REQD
PART OR IDENTIFYING NO
NOMENCLATURE OR DESCRIPTION
CODE IDENT
MATERIAL
DATA SPECIFICATION SIZES, NOTES, SUPPLIERS
ZONE
LINE NO.
LIST OF MATERIAL OR PARTS LIST
HEAT TREAT
FINISH
DO NOT SCALE PRINT
APPLICATION (USAGE) DATA
DR BY PRYOR
CHK BY
APPROVED BY
NORTH AMERICAN AVIATION, INC.
12214 LAKEWOOD BLVD., DOWNEY, CALIFORNIA
ASSEMBLY ~ APOLLO MODEL
FD-2 LAUNCH ESCAPE CONFIG.
(BALANCE OSCILLATION CENTER ON C.G.)
CODE IDENT NO. 03953
SIZE J
7121-01072
SCALE
SHEET

Figure 1

[redacted]



TOP
.650 TYP
.585 (TYP)
1.750 DIA (REF)
DRILL #7 (.201 DIA) THRU TYP 6 PLCS AS SHN
12° (TYP)
A
A
DRILL, TAP & C'BORE FOR #6-40UNF-3B x 7/16 12 EQ SPACES ON 7.860 B.C.
7.182
NASA 1600"# PITCH BALANCE DWG. 401896
.230
.100 CONST.
2.360
2°
7.180
.35 CONST
.25 R.
1.03 R. SPOTFACE
2°
30°
8.470 DIA
7.520 DIA
33°
.02 .03 RAD
.500
8.140 DIA
1.313
.847R
C'SINK .110 DEEP (TOP SCREW ONLY)
C.G.
1.750 DIA
2.00 DIA
1.931 (REF)
.25 (TYP 5 PLCS)
10.164R
B
5.775
6.680
6.450 (REF)
8.377 DIA @ SPLIT LINE (REF)
.417R
DRILL & C'SINK FOR 10-32UNF-3B FLAT HD SCREW TO MATCH NASA 1600" PITCH BALANCE AT POSITION SHOWN 6 PLACES
SECTION A-A
BREAK CORNERS TO FIT INTERNALLY ONLY, LEAVE EDGE SHARP ON ℄



2. MATL 7075-T6 ALUM 2
1. MODEL FACTOR = .055
NOTES UNLESS OTHERWISE SPECIFIED

REL No 2
DATE 2-13-62
JOB No 242-518

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REL #2 REVISED BASE ATTACHMENT & ADDED DIMEN 2-13-62

REQD	REQD	PART NO.	DESC	MATERIAL	SIZE	ZONE	MATL SPEC	QTY PER END ITEM	USED ON	NEXT ASSY

LIST OF MATERIAL — APPLICATION

DRILLED HOLE TOLERANCE
.040 TO .1285 +.001
.136 TO .228 +.001
.234 TO 1/2 +.001
33/64 TO 3/4 +.001
49/64 TO 1 +.001
1-1/64 TO 2 +.001

TOLERANCES EXCEPT AS NOTED
ANGLES ±1/2° DECIMALS .XX = ±.03 .XXX = ±.010
✓ SURFACE ROUGHNESS PER MIL-STD-10
HEAT TREAT
FINISH

DATE
DR BY PRYOR
CHK BY
APPD BY
APPD BY

MODEL ASSY-APOLLO FD-2 RE-ENTRY CONFIG (LANGLEY UPWT)

SCALE Full
WT

NORTH AMERICAN AVIATION, INC.
SPACE and INFORMATION SYSTEMS DIVISION
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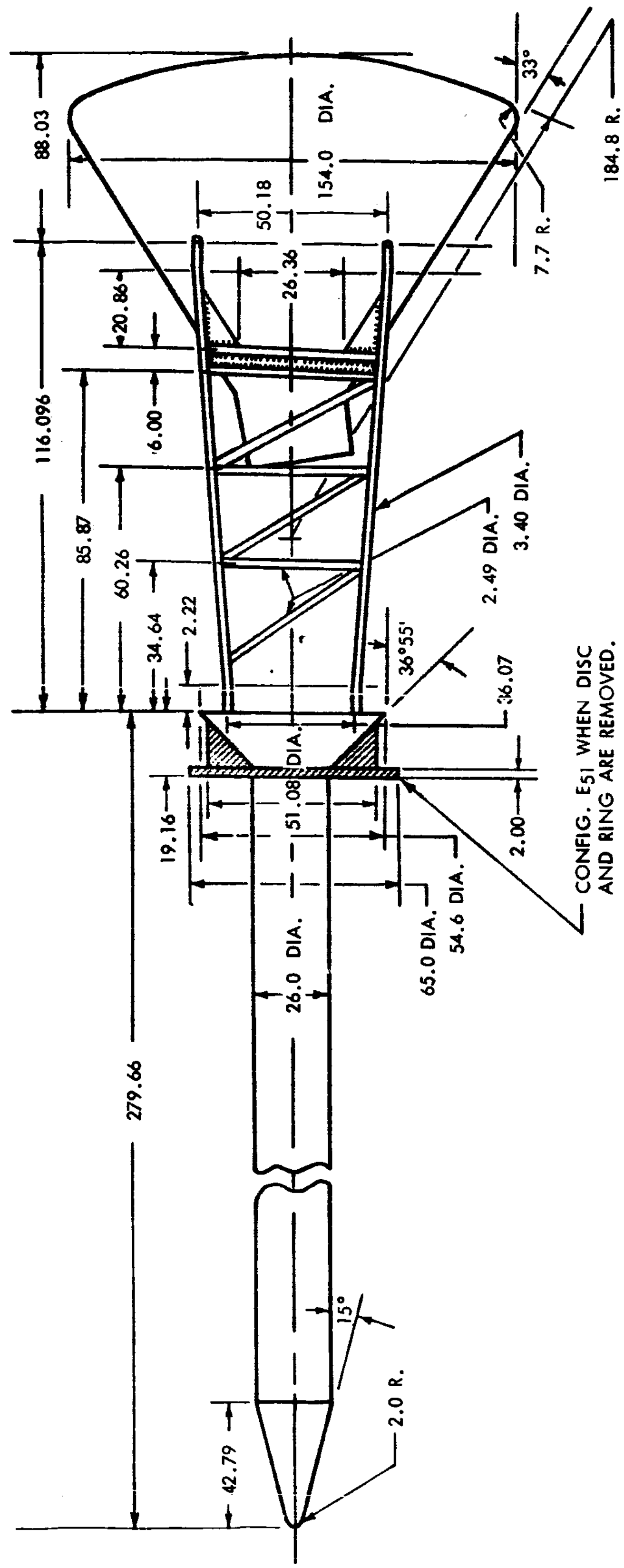
DWG SIZE
7121-01059

Figure 2

C[redacted]



FULL-SCALE DIMENSIONS IN INCHES
DRAWING NOT TO SCALE

Figure 3. LEV Configuration $E_{52}T_{21}C_{19}$

[redacted]

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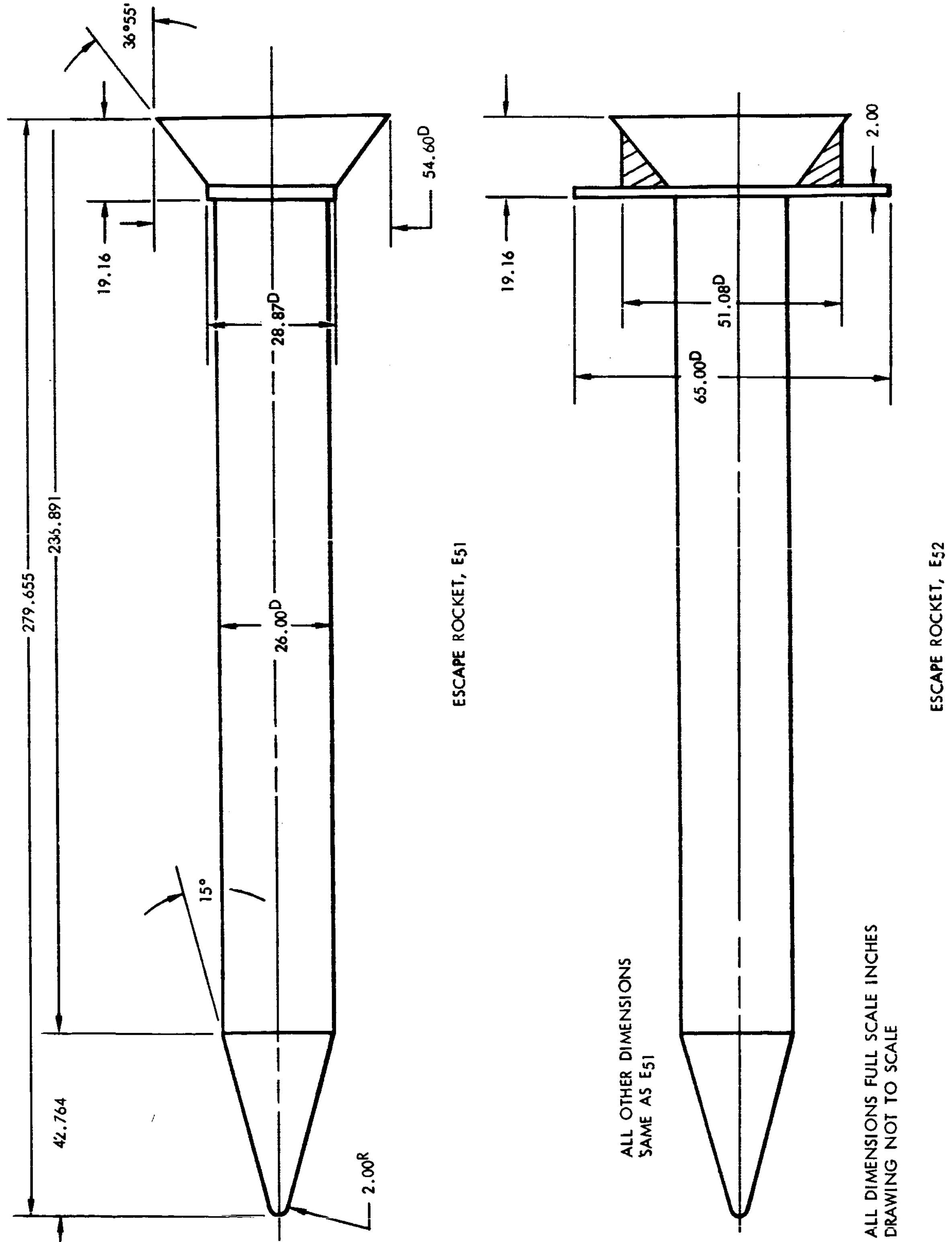

Figure 4. Escape Rocket Configurations

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[redacted]

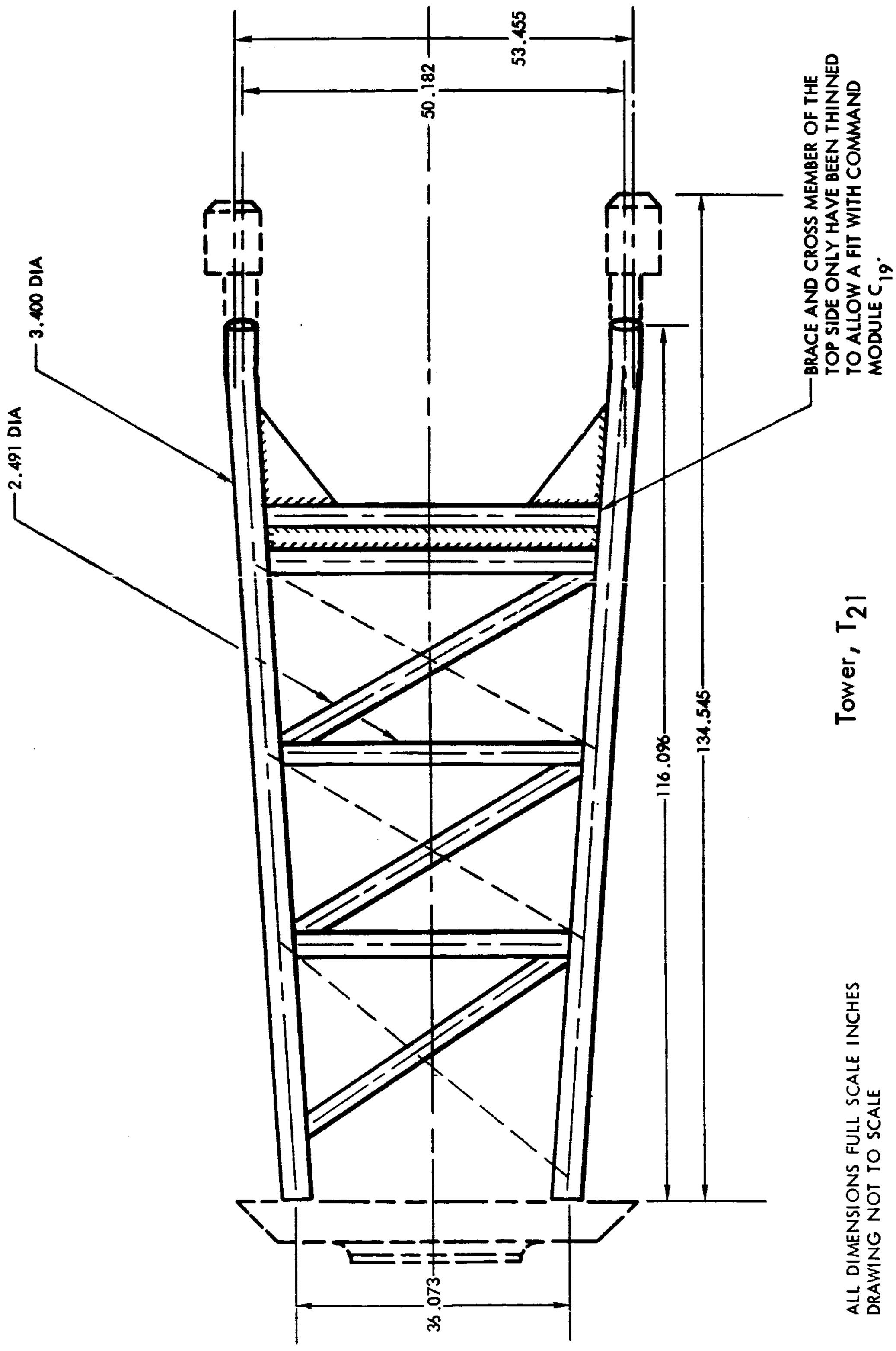

Figure 5. Tower Structure

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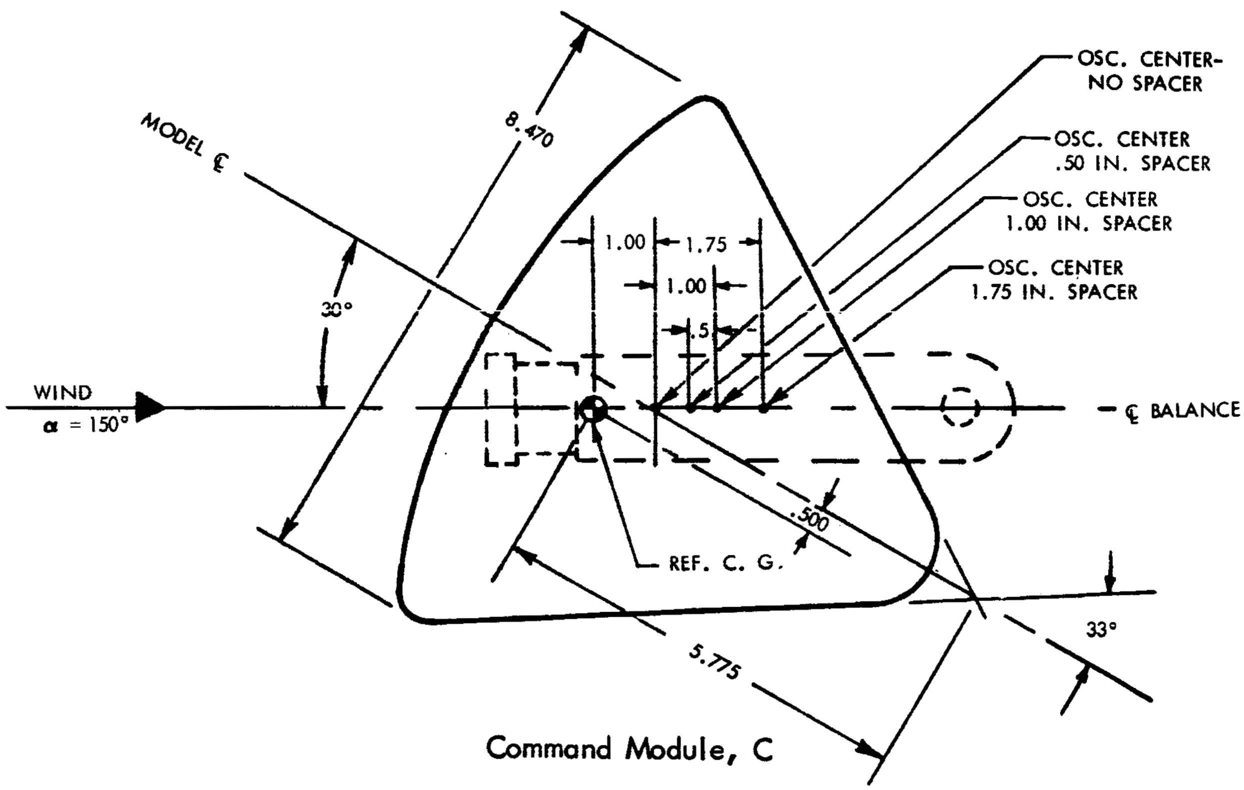

ALL DIMENSIONS MODEL SCALE INCHES
DRAWING NOT TO SCALE

Figure 6. Command Module Reentry Configuration Oscillation Center Location

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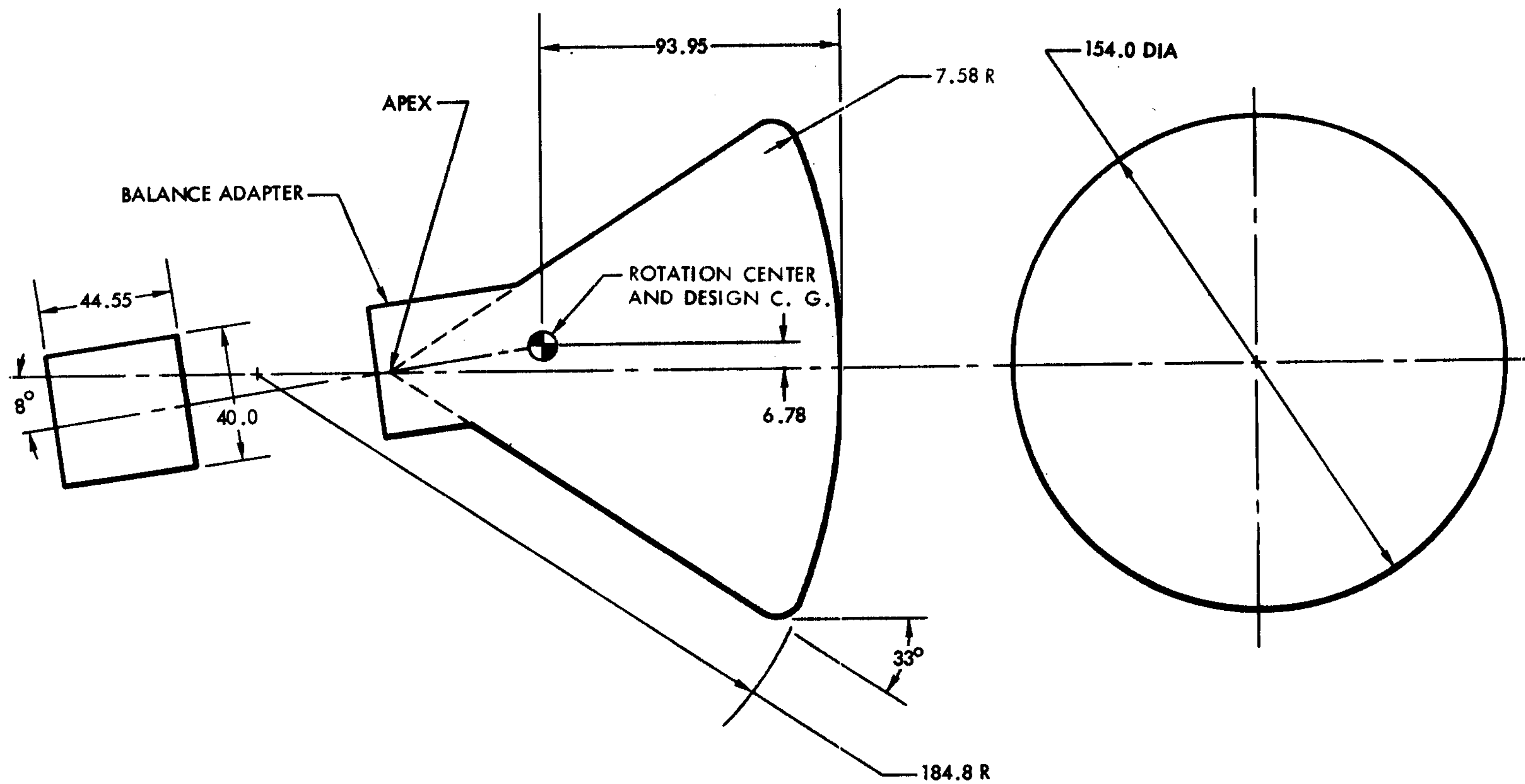

ALL DIMENSIONS FULL SCALE INCHES
DRAWING NOT TO SCALE

Command Module, C_{19}

Figure 7. Command Module for LEV Configuration

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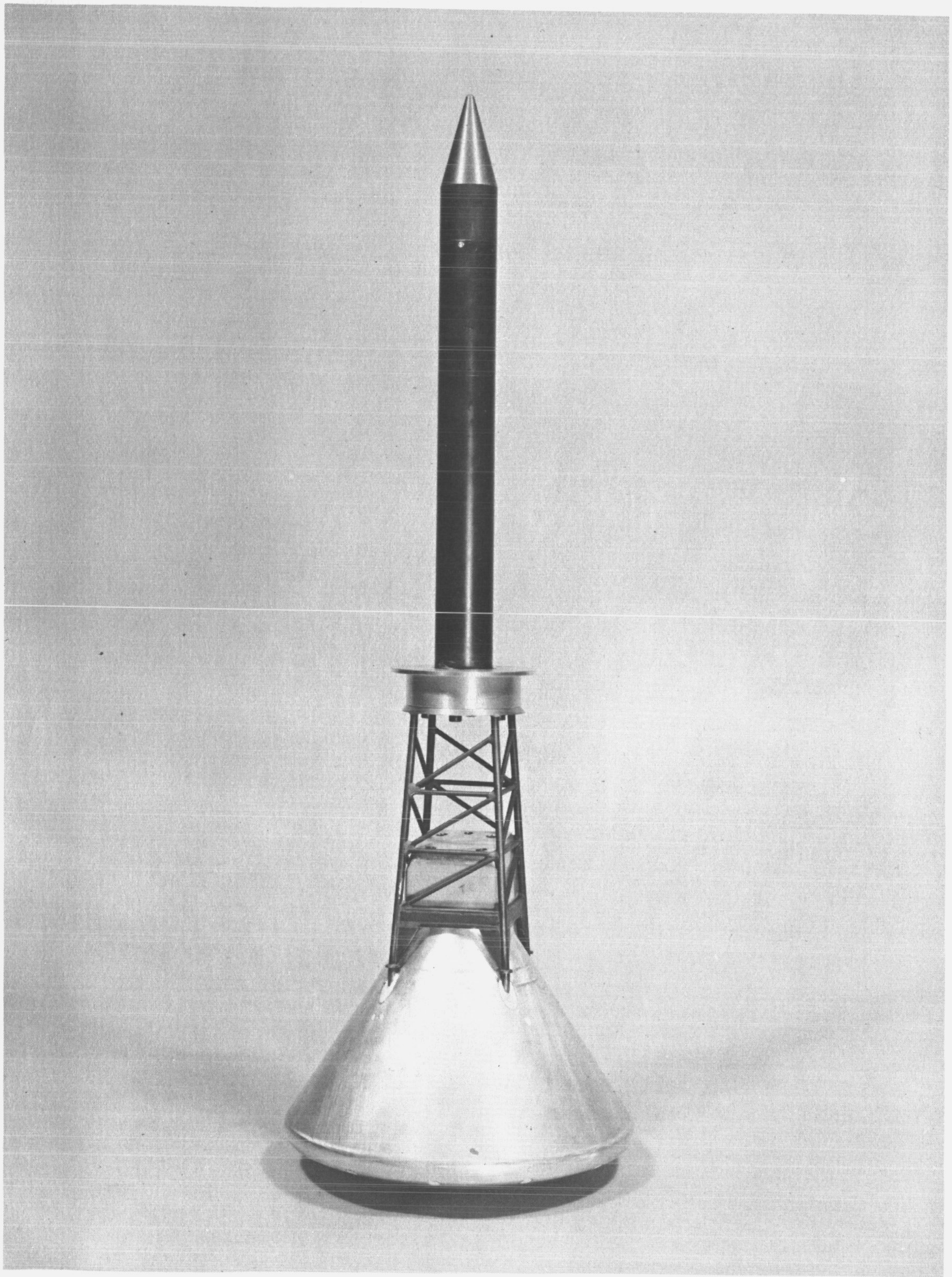

Figure 8. LEV With Flow Separator Disc

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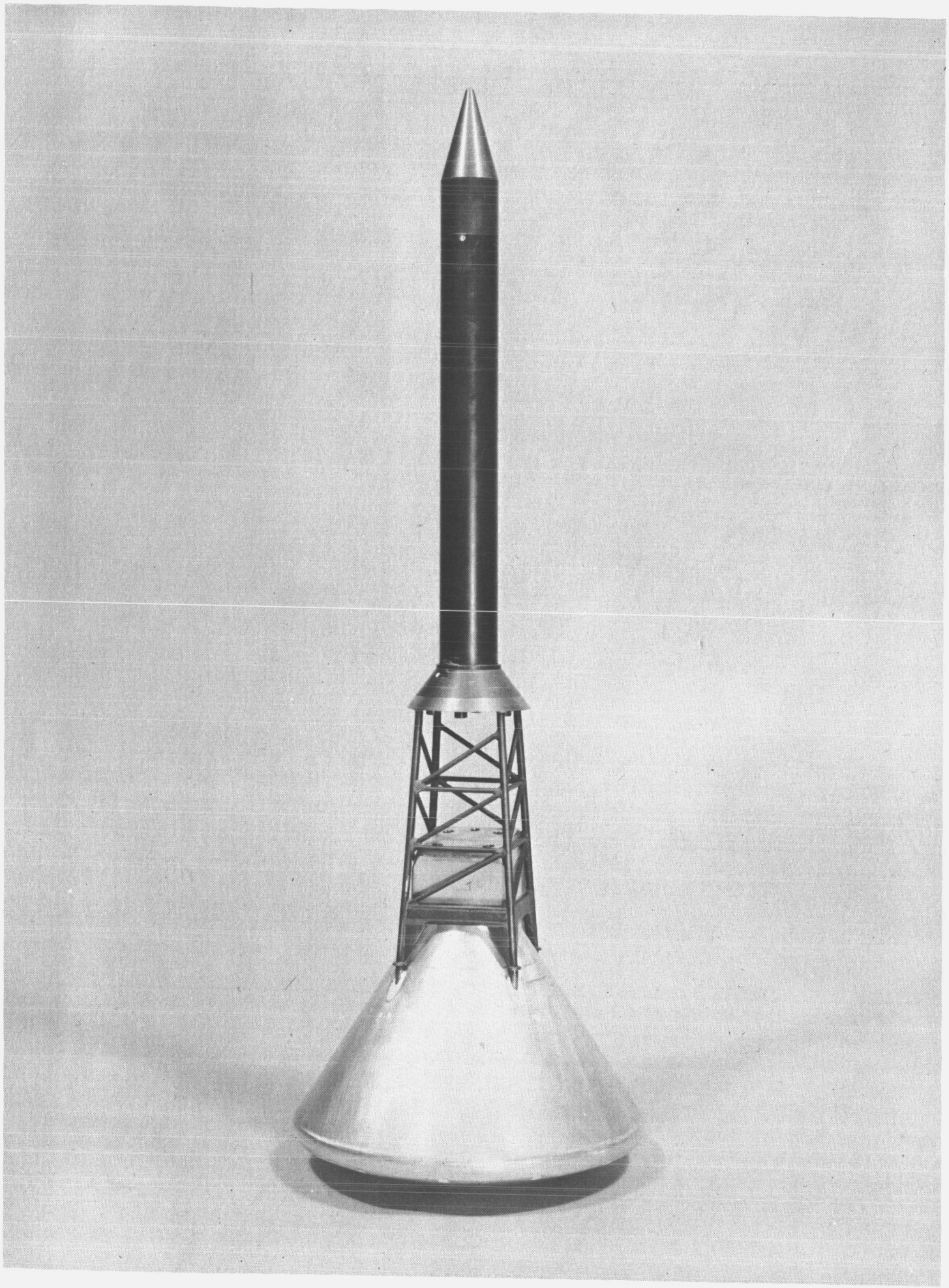

Figure 9. LEV Without Flow Separator Disc

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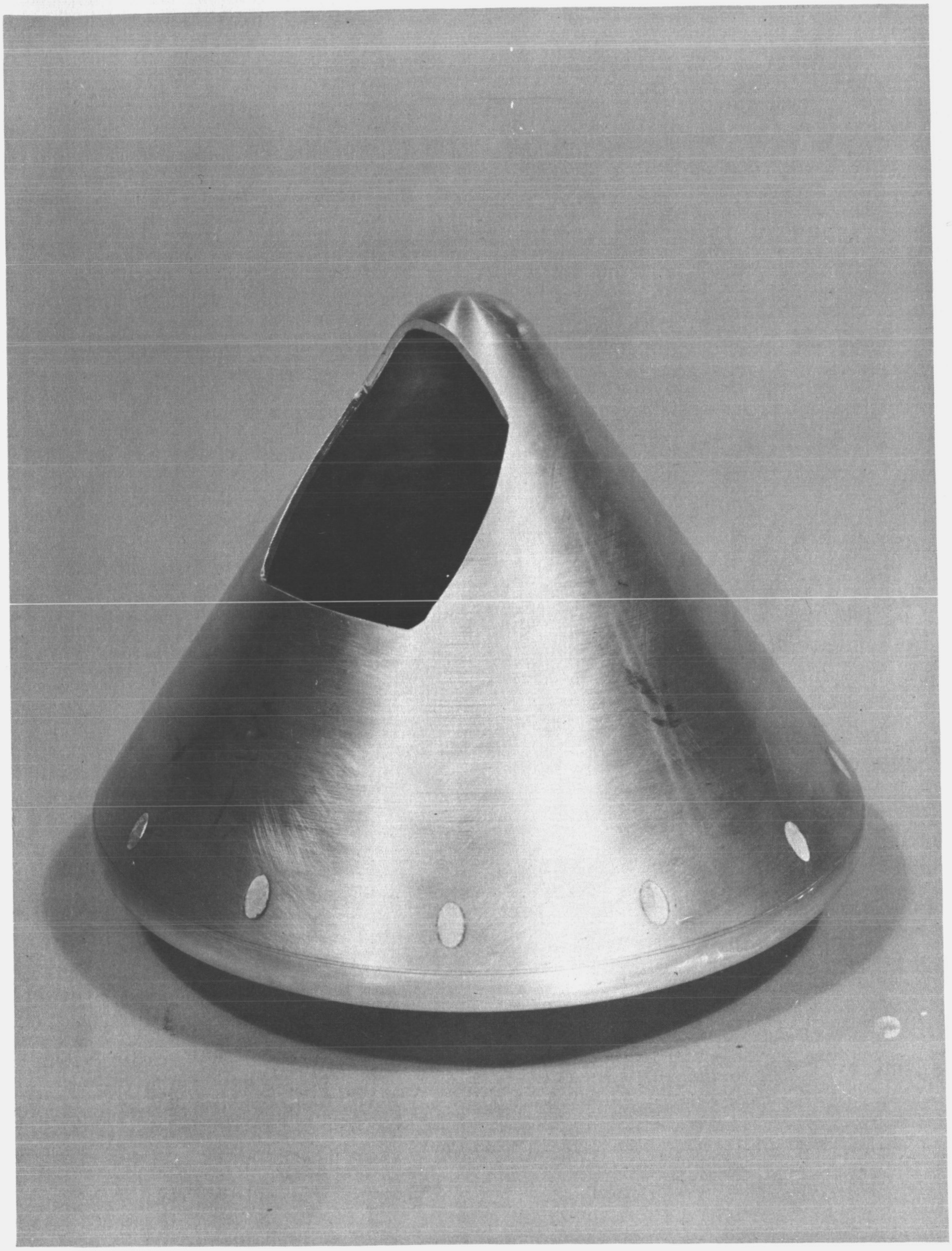

Figure 10. Command Module Reentry Configuration

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IV. TEST PROCEDURE

TEST NOMENCLATURE

The following nomenclature was used in this investigation.

A	Maximum cross-sectional area, ft^2, $\frac{\pi \ell^2}{4}$
ℓ	Maximum body diameter, ft
p	Free-stream static pressure, lb/ft^2
q_∞	Free-stream dynamic pressure, lb/ft^2
α	Angle of attack of model centerline, deg or radians
$\dot{\alpha}$	Rate of change of angle of attack, radians/sec
V	Free-stream velocity, ft/sec
M	Mach number
ω	Angular frequency of oscillation, radians/sec
k	Reduced frequency parameter, $\frac{\omega \ell}{V}$
R	Reynolds number based on ℓ
q	Angular velocity in pitch, radians/sec
$\dot{q}$	Rate of change of pitching angular velocity, $radians/sec^2$
I	Moment of inertia, $slug\text{-}ft^2$
C_m	Pitching moment coefficient, $\frac{\text{pitching moment}}{q_\infty A \ell}$
$C_{m_q} + C_{m_{\dot{\alpha}}}$	Damping-in-pitch parameter per radian
$C_{m_\alpha} - k^2 C_{m_{\dot{q}}}$	Oscillatory longitudinal stability parameter per radian

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MODEL INSTALLATION

The FD-2 model was installed on the NASA 1600 inch-pound dynamic balance (Drawing 401896) that was mounted on a straight sting containing the oscillating mechanism. The drive motor, clutch resolvers, and frequency generator were all contained in the downstream end of the sting, which was stiffened to provide a resonant frequency above the maximum oscillating frequency of the model. The oscillating mechanism was designed to provide maximum stiffness of all drive linkages so that the model responded only to the essentially sinusoidal forcing input of the crank and Scotch yoke.

The models were mounted so that the sting centerline and command module axis of symmetry formed a 30-degree angle for the entry configuration to allow testing through angles of attack of 136 to 154 degrees (also 146 to 164 degrees by rolling model 180 degrees) and an 8-degree angle for the launch escape configuration to allow testing through angles of attack of -12 to + 6 degrees. The 8-foot Transonic Pressure Tunnel dynamic balance sting support was attached to a tapered vertical strut that was connected to a motor-driven sector. The system was designed to keep the model on the tunnel centerline throughout the angle-of-attack range. In addition, the sting was rigidly braced to the tunnel walls by preloaded stay cables to restrict any sting motion.

INSTRUMENTATION

The NASA 1600 inch-pound dynamic pitch balance was used to measure the moment and displacement functions as the model was mechanically forced to oscillate in a single degree of freedom.

In operation of the system, calibrated outputs of the moment and displacement strain gages passed through coupled electrical sine-cosine resolvers that rotated at the frequency of oscillation. The resolvers transformed the outputs into orthogonal components from which the resultant applied moment and displacement and the phase angle between them were found. With the known oscillation frequency, the aerodynamic damping and oscillatory stability moments were computed.

All data were computed on a remotely located IBM 7090 computer.

DATA REDUCTION AND CONSTANTS

All data were reduced and presented in standard NASA coefficient form referred to the body system of axes originating at the oscillation center. The equations used in reducing the data are shown on the following page.

C – System damping moment in. -lb/rad/sec

K – System spring constant in. -lb/rad

$$C_{aero} = C_{run} - C_{tare}, \text{ where } C_{tare} = \text{constant}$$

$$(K - I\,\omega^2)_{aero} = (K - I\,\omega^2)_{run} - (K - I\,\omega^2)_{tare}$$

$$C_{m_q} + C_{m_{\dot{\alpha}}} = -\frac{VC_{aero}}{12\, q_\infty\, A\ell^2}$$

$$C_{m_\alpha} - k^2 C_{m_{\dot{q}}} = -\frac{(K - I\,\omega^2)_{aero}}{12\, q_\infty\, A\ell}$$

where

$$k = \frac{\omega\,\ell}{V}$$

$$q_\infty = 0.7\, p\, M^2$$

$$p = \frac{\text{Stagnation pressure}}{(1 + 0.2M^2)^{3.5}}$$

$$V = \frac{(49.0236)\,\sqrt{T_t}\, M}{(1 + 0.2M^2)^{1/2}};\quad T_t = \text{tunnel total temperature, °R}$$

$$\text{Reynolds number} = \frac{2\,\ell\, q_\infty}{\mu\, V};\quad \mu = \text{viscosity, } \frac{\text{lb-sec}}{\text{ft}^2}$$

The following were constants for the test:

$\ell = 0.7058$ ft

$A = 0.3912$ ft^2

DATA ACCURACY

The estimated probable errors of the aerodynamic test conditions for this test are as follows:

k, radians	±0.0001
M	±0.005
R	$\pm 0.005 \times 10^6$
α, degrees	±0.1

The ability of the forced oscillation equipment and instrumentation used in these tests to measure accurately the system damping and stability moments is discussed in Reference 5. These accuracies in measuring applied moments, based on repeatability in measuring the wind-off or tare moments of the model and mechanical system when translated to coefficient form using the dimensions of the 0.055-scale Apollo models, give these probable coefficient accuracies:

$C_{m_q} + C_{m_{\dot{\alpha}}}$	±0.06
$C_{m_\alpha} - k^2 C_{m_{\dot{q}}}$	±0.03

CO[redacted]

V. REFERENCES

1. Data Report for Langley 8-Foot TPT Wind Tunnel Tests (Project 233) of Apollo Model (FD-2). NAA S&ID SID 62-1065 (24 August 1962).

2. Data Report for Langley Unitary Plan Wind Tunnel Tests (Project 349) of Apollo Model (FD-2). NAA S&ID SID 62-536 (28 May 1962).

3. Data Report for Langley Unitary Plan Wind Tunnel Tests (Project 374) of Apollo Model (FD-2). NAA S&ID SID 62-1074 (24 August 1962).

4. Data Report for Tests of a 0.055-Scale Apollo Dynamic Stability Model (FD-2) in the Low Mach Leg of the Langley Unitary Plan Wind Tunnel (Project 398). NAA S&ID SID 63-96 (April 1963).

5. Dynamic - Longitudinal and Directional Stability Derivatives for a 45-Degree Sweptback-Wing Airplane Model at Transonic Speeds. NASA TM X-39 (August 1959).

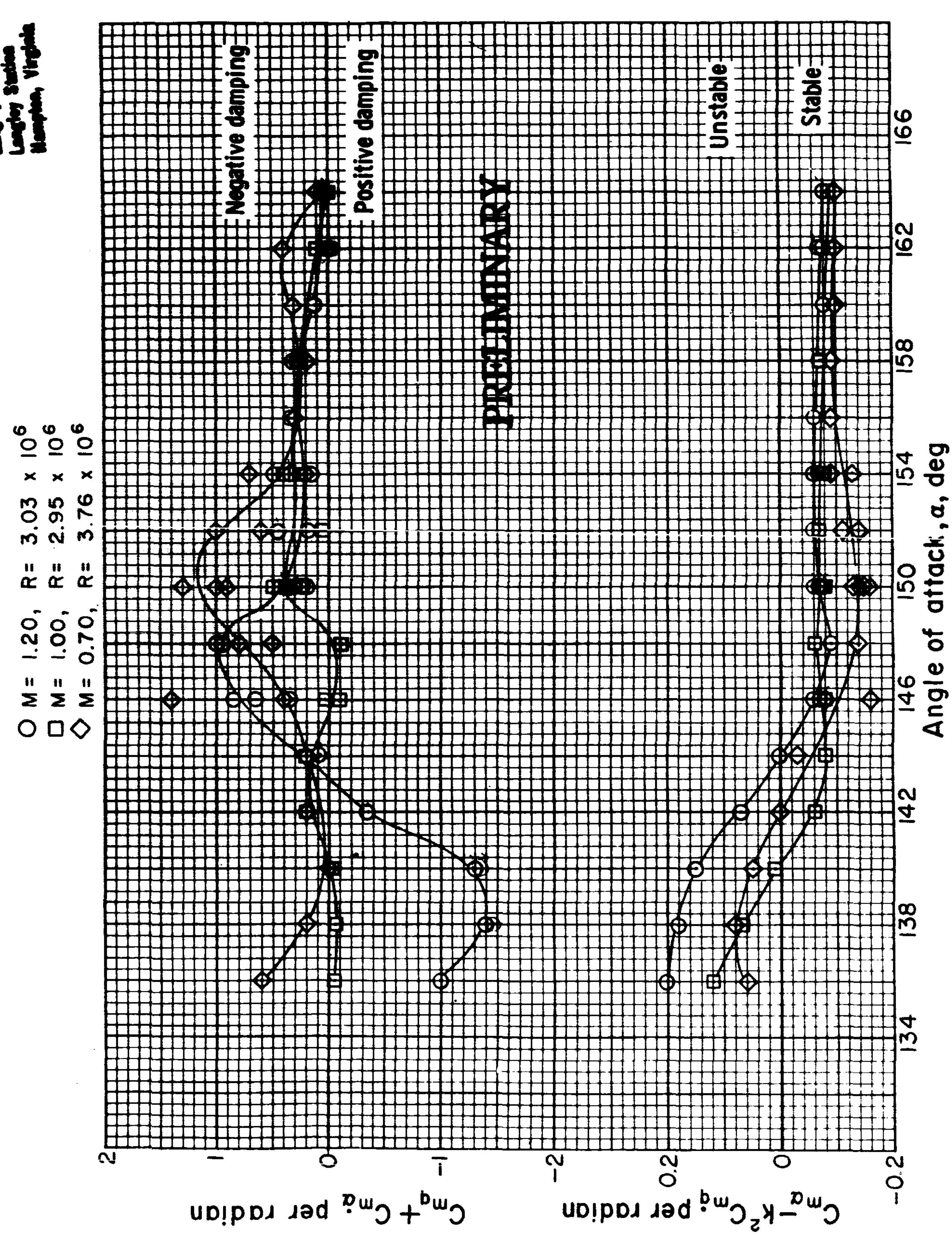
6. Structural Analysis of the 0.055-Scale Apollo Wind Tunnel Models. NAA S&ID SID 62-103 (16 February 1962).

C[redacted]

APPENDIX A

PLOTTED DATA

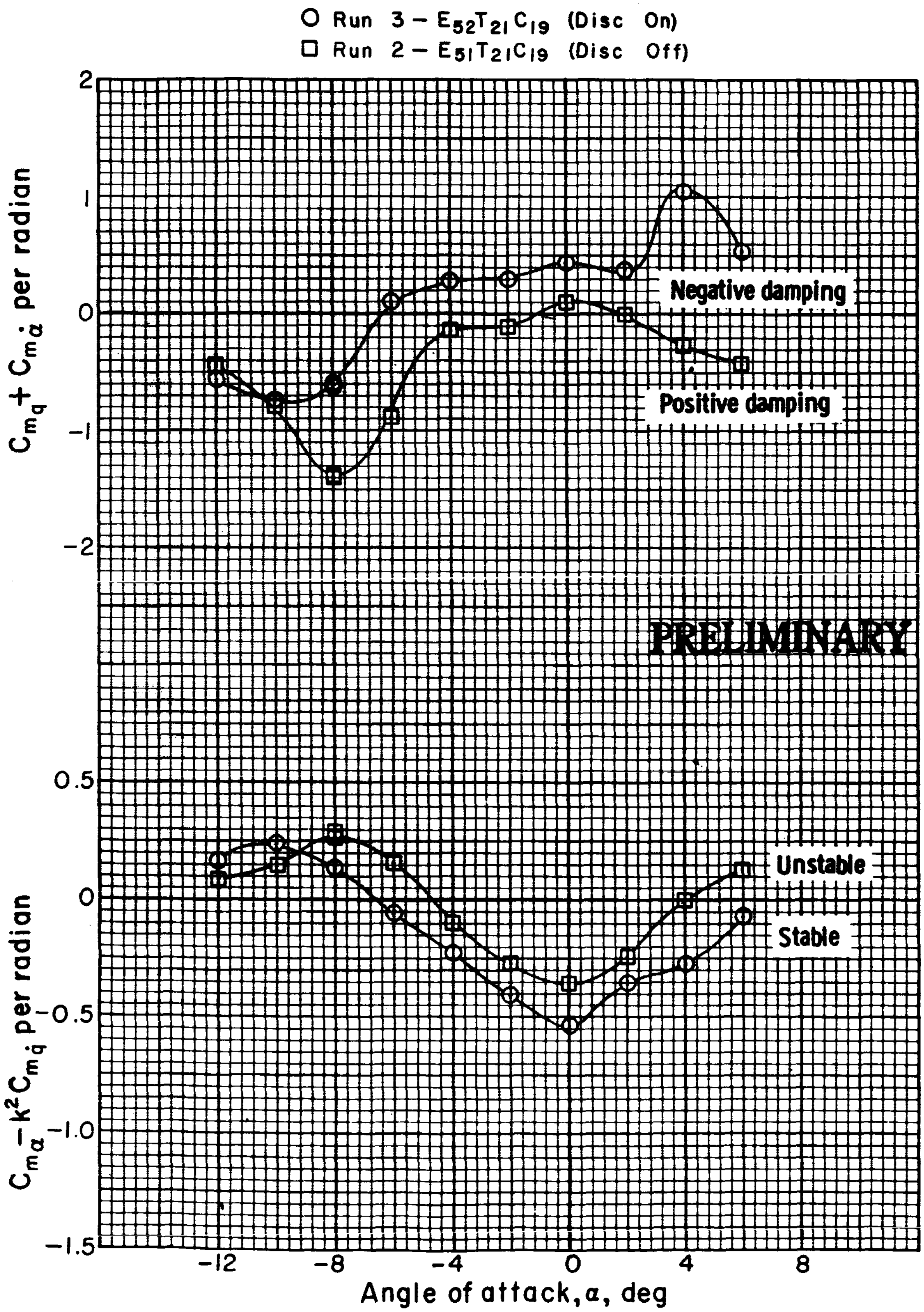
[redacted]



Effect of Mach No. Variation on Dynamic Stability Characteristics
Command Module Entry Configuration, C, with 0.50" Spacer (Runs 1 & 4)

[redacted]

[redacted]



Effect of Flow Separator Disc on Dynamic Stability Characteristics
Launch Escape Configuration, M = 0.30 R = 1.78×10^6

[redacted]

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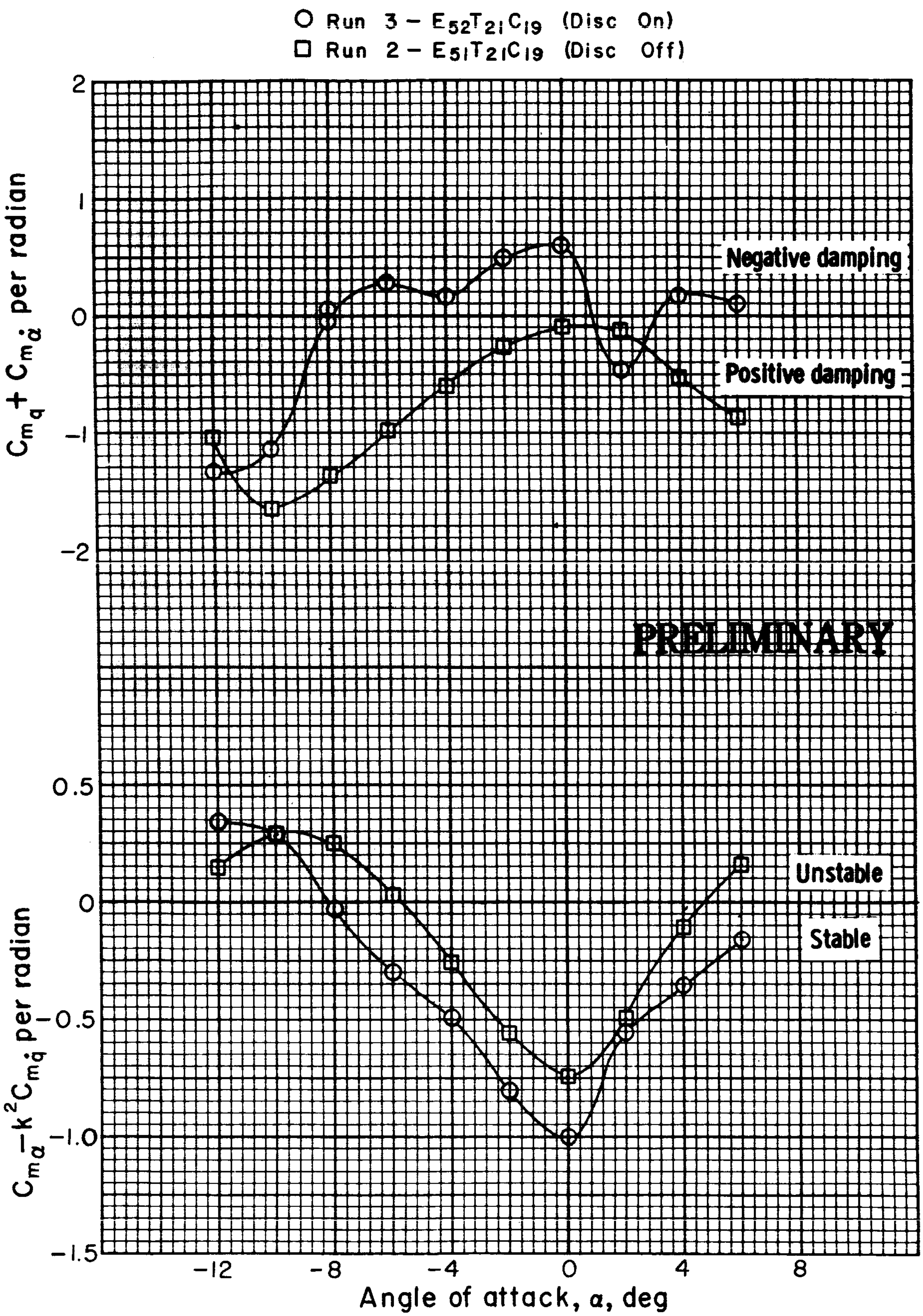

Effect of Flow Separator Disc on Dynamic Stability Characteristics
Launch Escape Configuration, M = 0.70 R = 3.02 x 10^6

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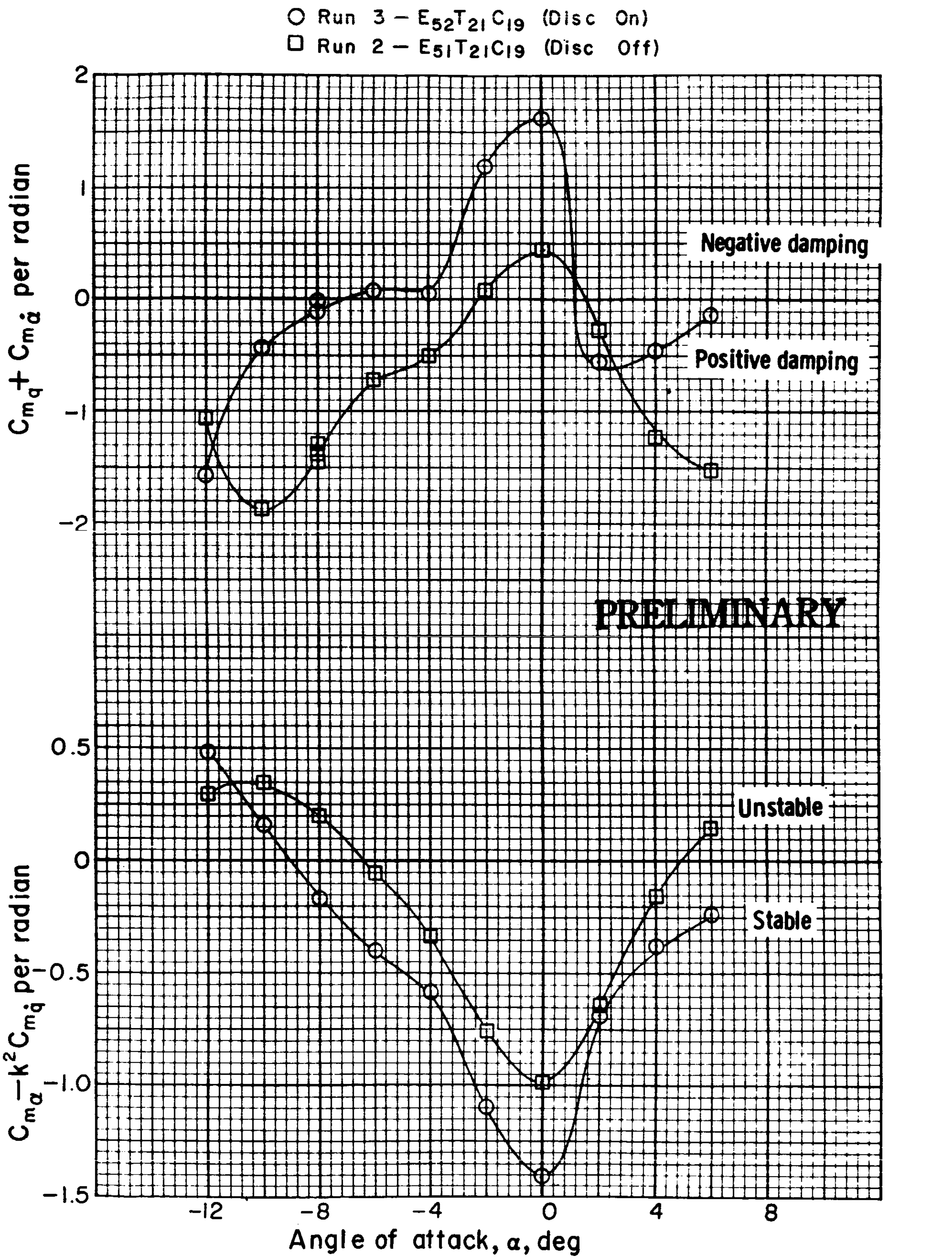
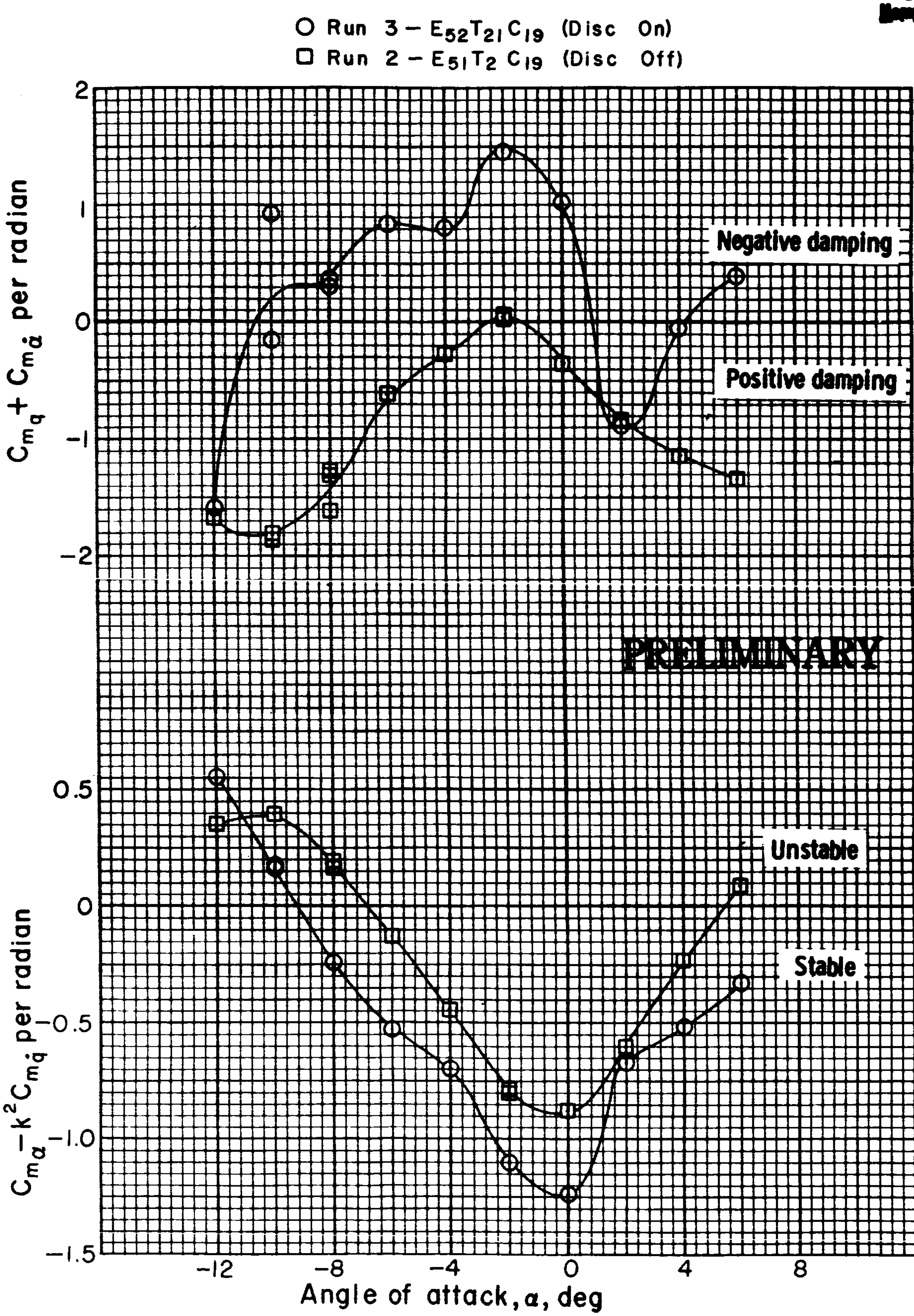
[redacted]



Effect of Flow Separator Disc on Dynamic Stability Characteristics
Launch Escape Configuration, $M = 0.90$ $R = 2.90 \times 10^6$

[redacted]

[redacted]



Effect of Flow Separator Disc on Dynamic Stability Characteristics
Launch Escape Configuration, M = 1.00 R = 2.97 x 10^6

[redacted]

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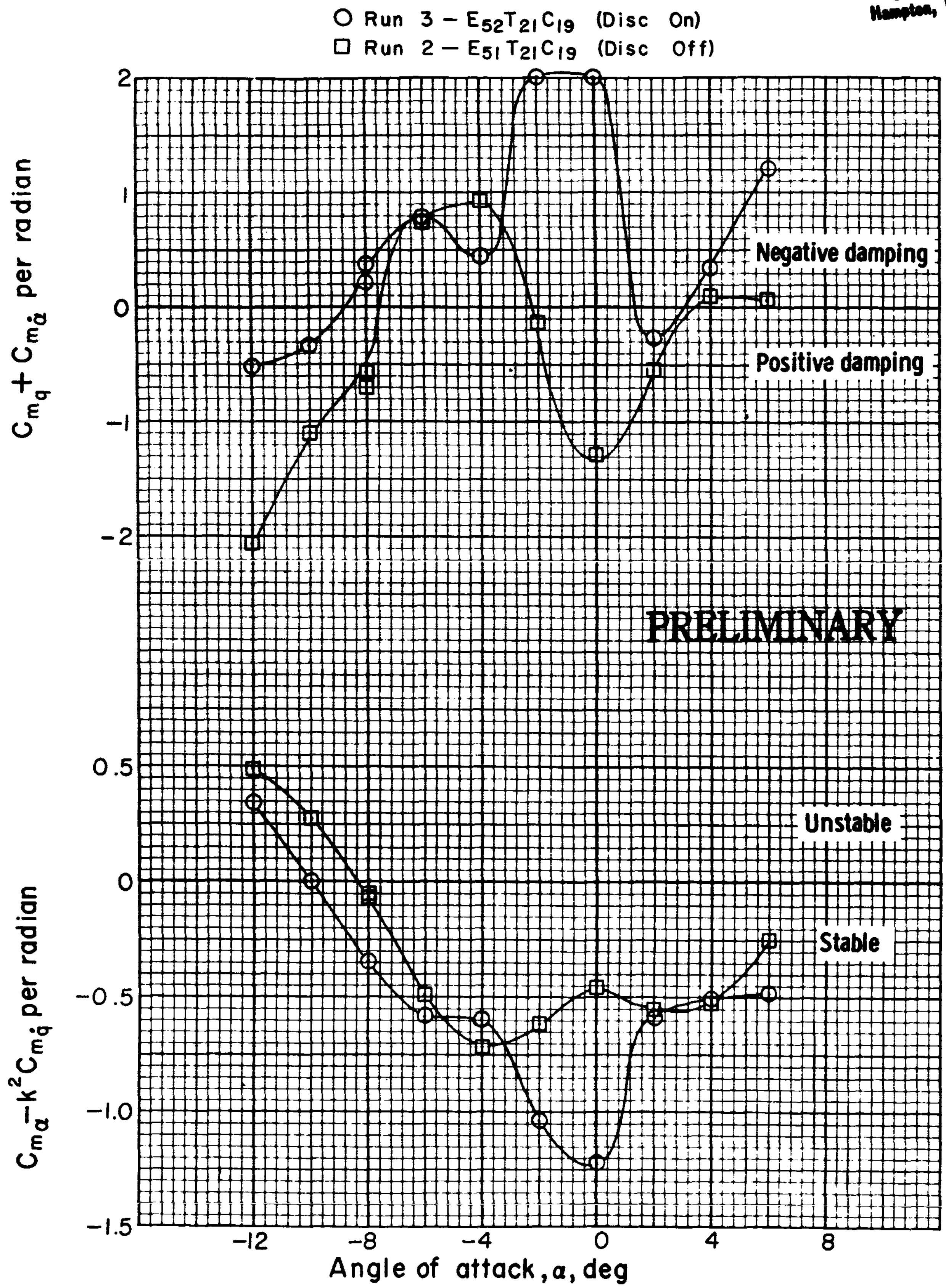

Effect of Flow Separator Disc on Dynamic Stability Characteristics
Launch Escape Configuration, M = 1.20 R = 3.05 x 10^6

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[redacted]

APPENDIX B

TABULATED DATA

[redacted]

[redacted]

RUN INDEX

Run No.	Configuration	Mach No.	Angle Range (deg)	R x 10^{-6}	Page
1	C - Reentry (Command Module rolled 180 deg 0.50-in. spacer)	0.70	146 to 164	3.76	B-3
		1.00		2.95	B-3
		1.20		3.03	B-4
		1.20		3.03	B-4
2	$E_{51}T_{21}C_{19}$ (launch escape vehicle, disc off)	0.30	-12 to +6	1.75	B-5
		0.70		2.99	B-5
		0.90		2.87	B-6
		1.00		2.98	B-6
		1.20		3.05	B-7
3	$E_{52}T_{21}C_{19}$ (launch escape vehicle, disc on)	0.30	-12 to +6	1.80	B-7
		0.70		3.05	B-8
		0.90		2.93	B-8
		1.00		2.96	B-9
		1.20		3.05	B-9
4	C - Reentry (command module at 0 deg roll, 0.50-in. spacer)	0.70	136 to 154	3.76	B-10
		1.00		2.95	B-10
		1.20		3.03	B-11

DATA FORMAT

Item or Column Heading	Definition
Config	Configuration No. 90003 - C, 0.50-inch spacer 90010 - $E_{51}T_{21}C_{19}$ 90011 - $E_{52}T_{21}C_{19}$
Velocity	Free-stream velocity, ft/sec
Q	Free-stream dynamic pressure, lb/ft^2
R	Reynolds number x 10^{-6} based on a reference length of 0.706 ft
Theta	Phase angle between driving torque and model displacement, deg
Disp	Amplitude of oscillation, radians
Beta	Angle of sideslip, deg
Alpha	Angle of attack, deg
k	Reduced frequency parameter, $\frac{\omega \ell}{V}$
CMQ	Damping-in-pitch parameter per radian, $C_{m_q} + C_{m_{\dot{\alpha}}}$
CMA	Oscillatory longitudinal stability parameter per radian, $C_{m_\alpha} - k^2 C_{m_{\dot{q}}}$

[redacted]

TEST 258 AT 8-FT TPT CONFIG 90003 REFERENCE LENGTH .706 FT.
RUN 1 10-23-62 MACH NO. .700 REFERENCE AREA .391 SQ.FT.
VELOCITY 780.5 TOTAL TEMPERATURE 108 DEG.F.

POINT	Q	R	THETA	DISP.	BETA	ALPHA	K	CMQ	CMA
32	777.6	3.771	263.75	.0344	.00	150.00	.0846	1.253	.156-
33	776.8	3.766	265.20	.0344	.00-	146.00	.0851	1.335	.162-
34	775.0	3.758	266.51	.0344	.00	150.00	.0808	.866	.133-
35	775.8	3.762	250.96	.0345	.00	154.00	.0747	.194	.085-
36	778.8	3.776	251.15	.0345	.00	156.00	.0758	.248	.091-
37	775.6	3.761	264.51	.0345	.00	158.00	.0753	.194	.093-
38	776.2	3.764	264.49	.0345	.00	160.00	.0761	.295	.099-
39	776.7	3.766	256.65	.0345	.00	162.00	.0770	.394	.100-
40	776.7	3.766	252.05	.0346	.00	164.00	.0767	.067	.103-
41	776.2	3.764	261.74	.0345	.00	152.00	.0779	.541	.108-
42	777.7	3.771	265.56	.0345	.00-	148.00	.0821	.761	.142-

TEST 258 AT 8-FT TPT CONFIG 90003 REFERENCE LENGTH .706 FT.
RUN 1 10-23-62 MACH NO. 1.000 REFERENCE AREA .391 SQ.FT.
VELOCITY 1066.5 TOTAL TEMPERATURE 108 DEG.F.

POINT	Q	R	THETA	DISP.	BETA	ALPHA	K	CMQ	CMA
23	774.9	2.948	263.23	.0343	.00-	149.99	.0538	.416	.079-
24	775.2	2.949	269.87	.0344	.00-	146.00	.0537	.025-	.082-
25	775.2	2.950	263.78	.0344	.00	150.00	.0536	.358	.078-
26	775.2	2.950	253.73	.0343	.00	153.99	.0536	.330	.075-
27	775.7	2.951	245.87	.0343	.00	158.00	.0535	.194	.074-
28	775.1	2.949	228.92	.0344	.00	162.00	.0548	.030	.090-
29	774.9	2.949	155.95	.0344	.00	164.00	.0549	.061-	.090-

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TEST 258 AT 8-FT TPT　　CONFIG 90003　　REFERENCE LENGTH .706 FT.
RUN 1　10-23-62　　MACH NO. 1.200　　REFERENCE AREA .391 SQ.FT.
VELOCITY 1235.3　　TOTAL TEMPERATURE 108 DEG.F.

POINT	Q	R	THETA	DISP.	BETA	ALPHA	K	CMQ	CMA
14	870.9	3.028	253.78	.0344	.00-	149.99	.0470	.110	.077-
15	871.0	3.029	269.44	.0345	.00-	146.00	.0475	.782	.084-
16	871.4	3.030	255.46	.0345	.00-	149.99	.0466	.170	.072-
17	871.2	3.029	267.61	.0344	.00	154.00	.0480	.421	.089-
18	871.3	3.030	263.67	.0344	.00	158.00	.0464	.249	.071-
19	871.5	3.030	149.06	.0344	.00	162.00	.0470	.055-	.077-
20	871.2	3.029	126.54	.0344	.00	164.00	.0468	.094-	.075-

TEST 258 AT 8-FT TPT　　CONFIG 90003　　REFERENCE LENGTH .706 FT.
RUN 1　10-23-62　　MACH NO. 1.200　　REFERENCE AREA .391 SQ.FT.
VELOCITY 1237.5　　TOTAL TEMPERATURE 110 DEG.F.

POINT	Q	R	THETA	DISP.	BETA	ALPHA	K	CMQ	CMA
45	871.0	3.015	259.33	.0358	.00-	149.99	.0464	.230	.072-
46	871.2	3.015	267.47	.0359	.00-	148.00	.0478	.928	.086-
47	871.2	3.015	263.74	.0361	.00-	146.00	.0463	.587	.070-
48	870.8	3.014	257.97	.0361	.00	150.00	.0455	.156	.063-
49	871.0	3.028	245.10	.0361	.00	152.00	.0456	.098	.062-
50	870.9	3.028	260.32	.0360	.00	154.00	.0465	.256	.072-
51	871.0	3.029	260.63	.0359	.00	156.00	.0455	.272	.061-
52	871.0	3.029	260.40	.0359	.00	158.00	.0464	.200	.071-
53	871.4	3.030	244.28	.0359	.00	159.99	.0469	.048	.076-
54	871.0	3.029	133.84	.0359	.00	162.00	.0468	.101-	.074-
55	871.3	3.030	197.28	.0359	.00	164.00	.0477	.017-	.083-

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TEST 258 AT 8-FT TPT
RUN 2 10-23-62

CONFIG 90010
MACH NO. .300
VELOCITY 348.0

REFERENCE LENGTH .706 FT.
REFERENCE AREA .391 SQ.FT.
TOTAL TEMPERATURE 110 DEG.F.

POINT	Q	R	THETA	DISP.	BETA	ALPHA	K	CMG	CMA
8	171.9	1.759	98.10	.0347	.00	8.00-	.0609	1.889-	.291
9	171.8	1.758	91.55	.0347	.00-	10.00-	.0679	1.293-	.145
10	171.7	1.757	79.55	.0347	.00-	12.00-	.0699	.941-	.093
11	172.1	1.761	90.31	.0348	.00	8.00-	.0614	1.914-	.268
12	172.3	1.763	92.63	.0348	.00	6.00-	.0673	1.398-	.159
13	171.9	1.759	81.94	.0347	.00	4.01-	.0790	.638-	.101-
14	172.0	1.760	57.44	.0347	.00	2.01-	.0854	.611-	.271-
15	171.6	1.756	104.34	.0347	.00	.06	.0898	.392-	.364-
16	171.5	1.755	105.93	.0348	.00	2.00	.0852	.513-	.242-
17	171.4	1.754	113.82	.0348	.00	4.00	.0755	.765-	.001-
18	171.5	1.755	70.04	.0348	.00	6.00	.0675	.930-	.135

TEST 258 AT 8-FT TPT
RUN 2 10-23-62

CONFIG 90010
MACH NO. .700
VELOCITY 781.8

REFERENCE LENGTH .706 FT.
REFERENCE AREA .391 SQ.FT.
TOTAL TEMPERATURE 110 DEG.F.

POINT	Q	R	THETA	DISP.	BETA	ALPHA	K	CMG	CMA
21	618.9	2.987	165.61	.0348	.00	8.00-	.0229	1.602-	.249
22	618.5	2.986	166.92	.0348	.00-	10.00-	.0229	1.882-	.290
23	618.1	2.984	140.03	.0348	.00-	12.00-	.0227	1.333-	.154
24	619.6	2.991	70.57	.0348	.00	6.01-	.0307	1.301-	.021
25	619.4	2.990	110.69	.0348	.00	4.01-	.0492	.905-	.258-
26	619.8	2.992	87.83	.0349	.00	2.00-	.0622	.567-	.573-
27	619.2	2.989	98.05	.0349	.00	.00	.0683	.408-	.734-
28	618.8	2.987	95.66	.0350	.00	1.99	.0590	.438-	.490-
29	619.3	2.989	68.10	.0349	.00	4.00	.0396	.050-	.106-
30	619.2	2.989	88.61	.0349	.00	6.00	.0184	1.194-	.158

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TEST 258 AT 8-FT TPT CONFIG 90010 REFERENCE LENGTH .706 FT.
RUN 2 10-23-62 MACH NO. .900 REFERENCE AREA .391 SQ.FT.
VELOCITY 977.1 TOTAL TEMPERATURE 110 DEG.F.

POINT	Q	R	THETA	DISP.	BETA	ALPHA	K	CMQ	CMA
33	711.0	2.870	165.65	.0349	.00	8.00-	.0191	1.558-	.200
34	710.6	2.869	171.79	.0350	.00-	10.01-	.0189	2.045-	.344
35	708.8	2.862	173.72	.0350	.00-	12.01-	.0188	1.280-	.289
36	701.1	2.830	165.00	.0350	.00	8.00-	.0191	1.722-	.208
37	694.3	2.803	79.85	.0350	.00	6.00-	.0299	1.066-	.058-
38	714.0	2.883	103.25	.0350	.00	4.00-	.0441	.854-	.341-
39	712.3	2.876	138.94	.0351	.00	2.01-	.0586	.272-	.761-
40	710.6	2.869	334.40	.0351	.00	.00	.0639	.076	.985-
41	708.8	2.861	77.79	.0351	.00	2.00	.0544	.610-	.642-
42	713.2	2.879	87.08	.0351	.00	4.00	.0362	1.552-	.172-
43	710.0	2.866	149.47	.0350	.00	6.00	.0202	1.833-	.141
44	712.9	2.878	167.03	.0350	.00	8.00-	.0204	1.637-	.211

TEST 258 AT 8-FT TPT CONFIG 90010 REFERENCE LENGTH .706 FT.
RUN 2 10-23-62 MACH NO. 1.000 REFERENCE AREA .391 SQ.FT.
VELOCITY 1066.5 TOTAL TEMPERATURE 108 DEG.F.

POINT	Q	R	THETA	DISP.	BETA	ALPHA	K	CMQ	CMA
47	784.6	2.985	164.71	.0348	.00	8.00-	.0188	1.558-	.168
48	784.5	2.985	173.51	.0349	.00-	10.01-	.0194	2.020-	.380
49	785.2	2.988	174.01	.0348	.00-	10.01-	.0166	1.952-	.379
50	785.6	2.989	173.58	.0350	.00-	12.00-	.0186	1.855-	.354
51	785.9	2.990	166.69	.0350	.00-	8.01-	.0187	1.573-	.185
52	785.3	2.988	73.44	.0350	.00	6.01-	.0314	.969-	.126-
53	784.4	2.985	120.35	.0350	.00	4.00-	.0461	.611-	.454-
54	784.0	2.983	144.14	.0350	.00	2.00-	.0566	.283-	.786-
55	785.6	2.989	100.43	.0351	.00	.00	.0590	.701-	.873-
56	785.0	2.987	90.18	.0351	.00	2.01	.0509	1.178-	.609-
57	784.7	2.986	80.28	.0351	.00	4.01	.0364	1.513-	.231-
58	784.6	2.985	107.72	.0350	.00	6.00	.0190	1.678-	.080
59	785.3	2.988	117.63	.0350	.00	1.99-	.0570	.701-	.803-
60	784.7	2.986	160.22	.0349	.00	8.00-	.0192	2.032-	.168

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TEST 258 AT 8-FT TPT
RUN 2 10-25-62

CONFIG 90010
MACH NO. 1.200
VELOCITY 1237.5

REFERENCE LENGTH .706 FT.
REFERENCE AREA .391 SQ.FT.
TOTAL TEMPERATURE 110 DEG.F.

POINT	Q	R	THETA	DISP.	BETA	ALPHA	K	CMQ	CMA
68	880.9	3.049	102.57	.0353	.00	8.00-	.0250	.913-	.062-
69	882.4	3.054	174.72	.0354	.00-	10.00-	.0109	1.478-	.271
70	882.4	3.054	176.33	.0355	.00-	12.00-	.0108	2.330-	.484
71	881.8	3.052	103.85	.0354	.00-	8.01-	.0253	1.047-	.068-
72	881.2	3.050	248.33	.0355	.00	6.00-	.0425	.385	.490-
73	881.3	3.050	266.82	.0355	.00	4.00-	.0491	.571	.717-
74	880.3	3.047	7.27	.0356	.00	2.00-	.0430	.500-	.624-
75	881.6	3.051	91.82	.0356	.00	.01-	.0416	1.657-	.469-
76	882.5	3.054	94.63	.0356	.00	1.99	.0442	.919-	.549-
77	882.0	3.053	158.76	.0356	.00	4.00	.0437	.259-	.526-
78	881.8	3.052	89.93	.0355	.00	6.00	.0341	.301-	.264-

TEST 258 AT 8-FT TPT
RUN 3 10-25-62

CONFIG 90011
MACH NO. .300
VELOCITY 344.9

REFERENCE LENGTH .706 FT.
REFERENCE AREA .391 SQ.FT.
TOTAL TEMPERATURE 100 DEG.F.

POINT	Q	R	THETA	DISP.	BETA	ALPHA	K	CMQ	CMA
63	171.8	1.798	89.87	.0350	.00	8.00-	.0658	.987-	.124
64	171.3	1.793	92.35	.0350	.00-	10.00-	.0609	1.128-	.227
65	171.6	1.796	92.83	.0350	.00-	11.99-	.0642	.936-	.159
66	171.9	1.798	97.83	.0350	.00	8.00-	.0658	1.021-	.131
67	171.1	1.790	110.11	.0350	.00	6.00-	.0743	.285-	.066-
68	171.5	1.794	221.88	.0350	.00	4.00-	.0807	.108-	.222-
69	171.7	1.797	240.84	.0350	.00	2.00-	.0874	.088-	.407-
70	171.7	1.797	251.51	.0350	.00	.00	.0918	.055	.531-
71	171.6	1.796	290.18	.0351	.00	1.99	.0855	.001-	.364-
72	171.5	1.795	268.58	.0351	.00	3.99	.0826	.666	.279-
73	171.7	1.796	269.75	.0351	.00	6.00	.0742	.156	.065-

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TEST 258 AT 8-FT TPT
RUN 3 10-25-62

CONFIG 90011
MACH NO. .700
VELOCITY 774.9

REFERENCE LENGTH .706 FT.
REFERENCE AREA .391 SQ.FT.
TOTAL TEMPERATURE 100 DEG.F.

POINT	Q	R	THETA	DISP.	BETA	ALPHA	K	CMQ	CMA
50	622.7	3.074	137.92	.0351	.00	8.00-	.0344	.265-	.034-
51	618.4	3.053	170.02	.0352	.00-	10.00-	.0176	1.426-	.289
52	618.9	3.056	171.98	.0352	.00-	12.00-	.0174	1.559-	.338
53	619.1	3.057	163.34	.0352	.00-	8.01-	.0345	.192-	.033-
54	619.4	3.058	233.80	.0352	.00	6.00-	.0485	.036	.299-
55	619.5	3.059	317.98	.0352	.00	4.00-	.0561	.097-	.487-
56	620.1	3.062	267.00	.0353	.00	2.00-	.0677	.249	.808-
57	619.7	3.060	267.60	.0354	.00	.00	.0736	.354	.997-
58	619.6	3.059	76.43	.0354	.00	2.00	.0582	.719-	.549-
59	619.1	3.057	240.78	.0353	.00	4.00	.0512	.371-	.364-
60	619.4	3.058	155.44	.0353	.00	6.00	.0413	.150-	.155-

TEST 258 AT 8-FT TPT
RUN 3 10-25-62

CONFIG 90011
MACH NO. .900
VELOCITY 968.5

REFERENCE LENGTH .706 FT.
REFERENCE AREA .391 SQ.FT.
TOTAL TEMPERATURE 100 DEG.F.

POINT	Q	R	THETA	DISP.	BETA	ALPHA	K	CMQ	CMA
37	708.5	2.926	129.40	.0352	.00	8.00-	.0348	.384-	.168-
38	708.8	2.928	150.11	.0352	.00-	10.00-	.0125	.681-	.163
39	708.7	2.927	175.85	.0353	.00-	12.00-	.0140	1.904-	.483
40	708.5	2.927	80.92	.0352	.00	8.00-	.0345	.286-	.170-
41	708.0	2.924	21.17	.0353	.00	6.01-	.0437	.206-	.402-
42	708.5	2.926	129.77	.0353	.00	4.01-	.0506	.217-	.590-
43	708.3	2.926	265.84	.0354	.00	2.01-	.0649	.925	1.103-
44	708.3	2.926	351.36	.0354	.00	.01-	.0578	1.371	1.408-
45	708.6	2.927	117.39	.0355	.00	2.00	.0541	.815-	.687-
46	708.4	2.926	92.33	.0354	.00	4.00	.0435	.732-	.384-
47	708.4	2.926	115.88	.0354	.00	5.99	.0378	.391-	.239-

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TEST 258 AT 8-FT TPT — CONFIG 90011 — REFERENCE LENGTH .706 FT.
RUN 3 10-25-62 — MACH NO. 1.000 — REFERENCE AREA .391 SQ.FT.
VELOCITY 1068.4 — TOTAL TEMPERATURE 110 DEG.F.

POINT	Q	R	THETA	DISP.	BETA	ALPHA	K	CMQ	CMA
23	781.4	2.960	240.71	.0352	.00	8.00-	.0351	.038	.236-
24	781.2	2.959	249.25	.0351	.00-	10.00-	.0075	.664	.164
25	781.1	2.959	175.30	.0353	.00-	10.00-	.0132	.453-	.174
26	781.4	2.960	176.35	.0353	.00-	12.00-	.0131	2.200-	.549
27	781.4	2.960	247.33	.0352	.00	8.00-	.0351	.095	.236-
28	781.3	2.959	265.90	.0353	.00	5.99-	.0457	.563	.531-
29	781.2	2.959	264.56	.0354	.00	4.00-	.0509	.540	.703-
30	781.2	2.959	350.49	.0354	.00	2.00-	.0509	1.190	1.109-
31	781.2	2.959	355.01	.0353	.00	.00	.0510	.774	1.237-
32	781.3	2.959	97.11	.0355	.00	2.00	.0501	1.155-	.673-
33	781.4	2.960	116.13	.0354	.00	4.00	.0453	.327-	.516-
34	781.2	2.959	257.23	.0354	.00	5.99	.0389	.122	.334-

TEST 258 AT 8-FT TPT — CONFIG 90011 — REFERENCE LENGTH .706 FT.
RUN 3 10-25-62 — MACH NO. 1.200 — REFERENCE AREA .391 SQ.FT.
VELOCITY 1237.5 — TOTAL TEMPERATURE 110 DEG.F.

POINT	Q	R	THETA	DISP.	BETA	ALPHA	K	CMQ	CMA
9	880.4	3.047	194.81	.0353	.00	8.00-	.0356	.062-	.345-
10	879.9	3.045	131.44	.0354	.00-	10.01-	.0204	.614-	.000
11	882.3	3.054	178.01	.0353	.00-	12.00-	.0119	.820-	.338
12	881.8	3.052	257.35	.0354	.00	8.00-	.0356	.111	.352-
13	881.9	3.052	265.84	.0354	.00	6.00-	.0426	.522	.574-
14	881.5	3.051	253.32	.0355	.00	4.00-	.0433	.168	.598-
15	881.1	3.049	349.04	.0355	.00	2.00-	.0433	1.797	1.034-
16	880.3	3.047	352.35	.0354	.00	.01	.0431	1.823	1.226-
17	879.9	3.046	77.17	.0355	.00	2.00	.0426	.544-	.583-
18	879.6	3.044	240.96	.0356	.00	4.00	.0407	.079	.509-
19	882.4	3.054	268.76	.0356	.00	6.00	.0400	.933	.487-

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TEST 258 AT 8-FT TPT
RUN 4 10-25-62

CONFIG. 90003
MACH NO. .700
VELOCITY 781.8

REFERENCE LENGTH .706 FT.
REFERENCE AREA .391 SQ.FT.
TOTAL TEMPERATURE 110 DEG.F.

POINT	Q	R	THETA	DISP.	BETA	ALPHA	K	CMQ	CMA
34	777.2	3.752	278.35	.0347	.00	150.00	.0801	.905	.143-
35	776.8	3.750	266.59	.0347	.00-	152.00	.0820	.895	.144-
36	776.4	3.748	263.27	.0347	.00-	154.00	.0798	.564	.125-
37	777.7	3.754	280.95	.0347	.00	150.00	.0817	.797	.159-
38	777.7	3.754	261.77	.0347	.00	148.00	.0814	.439	.137-
39	777.5	3.753	237.48	.0348	.00	146.00	.0761	.326	.084-
40	778.5	3.758	231.39	.0348	.00	144.01	.0665	.060	.029-
41	776.8	3.750	251.45	.0348	.00	142.00	.0622	.116	.004-
42	776.6	3.749	24.12	.0348	.00	140.01	.0504	.085-	.052
43	776.5	3.748	226.29	.0348	.00	138.00	.0478	.101	.076
44	776.4	3.748	265.23	.0348	.00	136.00	.0495	.506	.064

TEST 258 AT 8-FT TPT
RUN 4 10-25-62

CONFIG 90003
MACH NO. 1.000
VELOCITY 1068.4

REFERENCE LENGTH .706 FT.
REFERENCE AREA .391 SQ.FT.
TOTAL TEMPERATURE 110 DEG.F.

POINT	Q	R	THETA	DISP.	BETA	ALPHA	K	CMQ	CMA
21	781.7	2.961	259.00	.0346	.00	150.00	.0530	.244	.072-
22	781.7	2.961	169.66	.0346	.00-	152.00	.0531	.075-	.072-
23	781.7	2.961	242.48	.0346	.00-	154.00	.0532	.136	.071-
24	781.7	2.961	264.35	.0346	.00	150.00	.0531	.244	.074-
25	781.8	2.961	104.24	.0347	.00	148.00	.0518	.239-	.061-
26	781.4	2.960	111.85	.0348	.00	146.00	.0524	.210-	.066-
27	781.9	2.962	238.80	.0348	.00	144.00	.0544	.080	.084-
28	781.6	2.960	240.84	.0348	.00	142.01	.0515	.074	.056-
29	781.8	2.961	118.90	.0348	.00	140.00	.0440	.158-	.006
30	781.7	2.961	110.17	.0348	.00	138.01	.0357	.180-	.066
31	781.8	2.961	118.90	.0349	.00	135.99	.0271	.166-	.115

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TEST 258 AT 8-FT TPT
RUN 4 10-25-62

CONFIG 90003
MACH NO. 1.200
VELOCITY 1237.5

REFERENCE LENGTH .706 FT.
REFERENCE AREA .391 SQ.FT.
TOTAL TEMPERATURE 110 DEG.F.

POINT	Q	R	THETA	DISP.	BETA	ALPHA	K	CMQ	CMA
8	878.8	3.042	258.72	.0348	.00-	150.01	.0459	.208	.066-
9	878.6	3.041	261.56	.0348	.00-	152.00	.0450	.314	.056-
10	878.9	3.042	226.29	.0348	.00-	154.00	.0458	.004	.063-
11	878.7	3.041	256.93	.0348	.00	150.00	.0460	.217	.066-
12	878.8	3.042	266.55	.0348	.00	148.00	.0478	.814	.085-
13	878.4	3.040	258.32	.0348	.00	146.00	.0450	.204	.056-
14	878.9	3.042	221.95	.0348	.00	144.01	.0385	.041-	.000
15	879.2	3.043	105.99	.0349	.00	142.00	.0302	.462-	.065
16	878.8	3.042	97.97	.0350	.00	140.00	.0122	1.477-	.147
17	878.9	3.042	150.53	.0351	.00	138.01	.0109	1.566-	.177
18	878.6	3.041	165.94	.0350	.00	136.00	.0109	1.129-	.195

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